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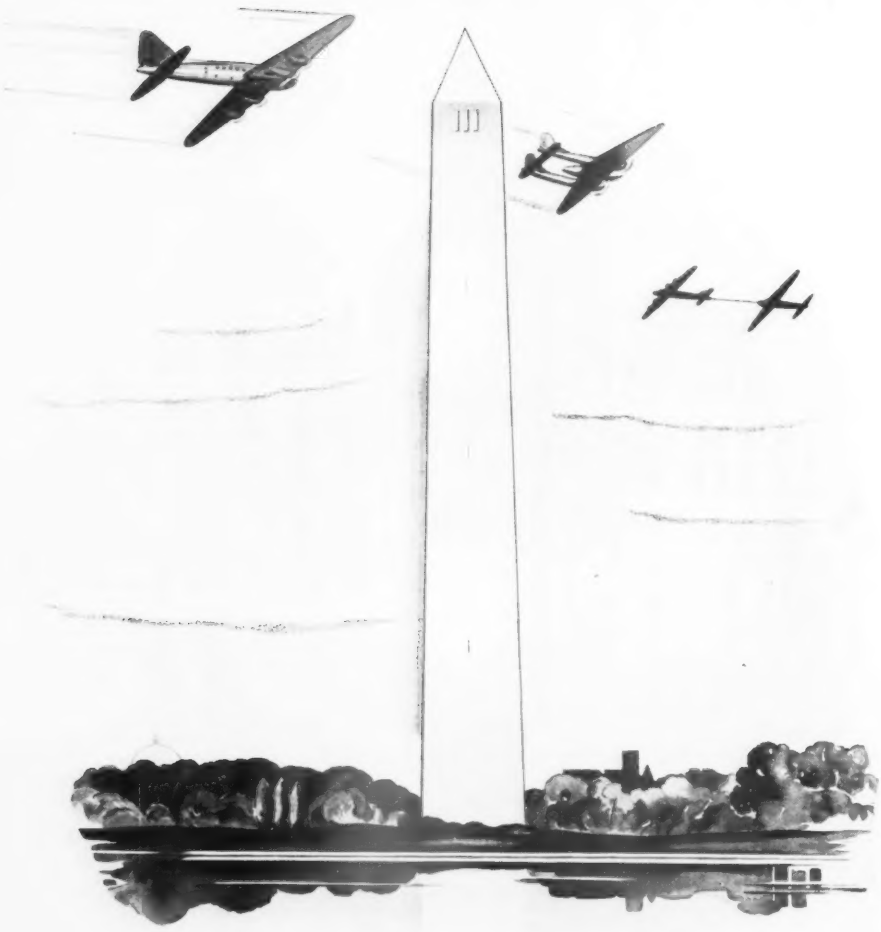

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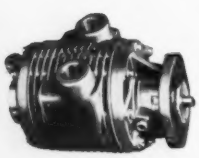

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1931

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Magnesium in German Aircraft

H. W. SCHMIDT

The Dow Chemical Company

Introduction

A number of German aircraft have been shipped to this country for examination. A brief illustrated description of a Messerschmitt Me 110 was published in *Life* magazine.[1] Some of the results of technical examination of these aircraft have also been published. An excellent summary of the design details of the Messerschmitt Me 110 is given in an article by Thompson[2] and additional data are published in the Canadian literature.[3] A description of the power plant is given in a paper by Young.[4]

A discussion of the design features of the Jumo 211 engine used on the Junkers Ju 88 plane is given in *Flight* magazine.[5]

The Messerschmitt Me 110 is of the fighter-light bomber type, while the Junkers Ju 88 is a medium-sized dive bomber. Both are twin-engined planes.

The total weight of the Messerschmitt Me 110 was approximately 9,900 lbs.; of this, approximately 300 lbs. were magnesium parts. The magnesium propeller reduction gear housing was cast on February 5, 1937, and it is believed that the plane was assembled early in 1938. As it was downed in England in the fall of 1940, the service life was approximately two and one-half years.

The gross weight of the Junkers Ju 88 plane was 24,000 lbs. The actual weight of magnesium parts on this plane totaled about 850 lbs. of which 300 lbs. were on the engines.

This report is the result of an examination conducted in the laboratories of The Dow Chemical Company of magnesium parts from a Messerschmitt Me 110 and a Junkers Ju 88 plane.

In studying the magnesium parts, all were given radiographic examination, spectrographic analysis, and metallographic study, as well as an examination of chemical treatment and paint coating, a corrosion study of base material, and a mechanical property determination where possible. Other details of interest which illustrate German practice were also noted. These will all be discussed under the various forms such as sand castings, forgings, etc. Not all of the parts examined are discussed or illustrated in this paper, only those that are typical or of particular interest.

Presented at the Materials Session, Eleventh Annual Meeting, I.Ae.S., New York, January 25–29, 1943.

Alloys Used

The magnesium alloys used by the Germans in these airplanes are shown in Table 1, which also gives the nominal composition, the German designation, and the equivalent American alloy.

The casting alloy Elektron AZG used by the Germans corresponds to Dowmetal H. The Germans always use this alloy in the as-cast condition, which is contrary to the usual American practice of solution heat-treating for greater ductility and toughness.

The German sand casting alloys A9, A10, and AZ31 have no American counterpart. The German literature states that alloys A9 and A10 are used in the heat-treated state, designated as A9v and A10v, or in the heat-treated and aged state, designated as A9h and A10h. Dowmetal O, R, and FS correspond generally in composition with the German alloys A9, A10, and AZ31, respectively, but are not used as sand casting alloys. The German alloy AZF is not used in this country.

It might be well to add a word of explanation of the German designations for heat-treatment. Where only the alloy number is given it means the as-cast state; thus, A9, AZ91, and AZG are all in the as-cast condition. Whenever the material is heat-treated the designation v is added; thus, A9v, A10v, etc., are heat-treated materials. If the alloy is heat-treated and aged the designation h is added—thus, A9h, A10h, etc.

The die casting alloy AZ91 is the same composition as Dowmetal R.

In the wrought alloys, the German and American materials are substantially equivalent compositions.

Sand Castings

A total of 123 large and small castings were examined from both planes. The distribution of the number of castings as to alloy and state is shown in Table 2, which also shows the number of cast-

Table 1

Designation and Composition of German Alloys

German Designation Elektron	—Nominal Composition— Al, %	Zinc, %	Mn, %	Condition	American Equivalent Dowmetal Alloy
AZG	6	3	0.2	Sand cast	H
A9	8.5	0.5	0.2	Sand cast	O
A9v	8.5	0.5	0.2	Sand cast and solution heat-treated	O-HT
A9h	8.5	0.5	0.2	Sand cast and solution heat-treated and aged	O-HTA
A10	9.5	0.5	0.2	Sand cast	R
A10v	9.5	0.5	0.2	Sand cast and solution heat-treated	R-HT
AZ31	3	1	0.3	Sand cast	FS
AZF	4	3	0.2	Sand cast	
AZ91	9.5	0.5	0.2	Die cast	R
AZM	6	1	0.2	Extrusion and forgings	J
AZ855	8.5	0.5	0.2	Forgings	O
AM503	...	...	1.5	Extrusion, sheet, and forgings	M

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TABLE 2

Number of Castings for Each Composition and State

	Composition and State									
	6 Al, 3 Zn	8½ Al, ½ Zn			9½ Al, ½ Zn			4 Al, 3 Zn	3 Al, 1 Zn	
	AZG	A9	A9v	A9h	A10	A10v	A10h	AZF	AZ31	
Plane	as-cast	as-cast	HT	HTA	as-cast	HT	HTA	as-cast	as-cast	Total
Messerschmitt	7	14	5	..	4	..	..	2	2	34
Junkers	25	6	33	2	..	3	..	..	20	89
Total	32	20	38	2	4	3	..	2	22	123

TABLE 3

Compositions of Castings

Alloy		Al	Cu	Fe	Mn	Ni	Si	Zn	Corrosion Rate, Mg./Sq.Cm./Day
AZG	Maximum	6.4	0.32	0.023	0.36	0.003	0.23	3.1	29.0
	Minimum	5.8	0.02	0.003	0.10	<0.001	<0.01	2.3	0.3
	Average	6.1	0.12	0.009	0.20	0.0013	0.12	2.7	3.7
A9	Maximum	8.6	0.36	0.022	0.41	0.004	0.14	1.0	25.2
	Minimum	7.9	0.07	0.003	0.17	<0.001	0.03	0.35	2.0
	Average	8.2	0.15	0.009	0.27	0.0012	0.09	0.61	10.2
A9v	Maximum	8.7	0.10	0.022	0.27	0.002	0.27	1.10	48.6
	Minimum	7.7	0.02	0.001	0.11	0.001	0.03	0.43	0.5
	Average	8.2	0.06	0.013	0.19	0.001	0.13	0.55	23.5
A9h		8.7	0.06	0.023	0.24	0.001	0.09	0.68	2.7
A10	Maximum	10.5	0.16	0.015	0.32	0.001	0.18	0.75	34.2
	Minimum	9.1	0.04	0.001	0.19	0.001	0.04	0.49	0.4
	Average	9.7	0.10	0.007	0.25	0.001	0.11	0.64	15.9
AZ31	Maximum	3.3	0.05	0.024	0.35	0.002	0.07	1.10	29.5
	Minimum	2.9	0.01	0.001	0.19	<0.001	<0.01	0.75	0.1
	Average	3.1	0.03	0.009	0.27	0.001	0.03	0.89	9.4
AZF	Maximum	4.4	0.24	0.042	0.32	<0.001	0.20	2.9	1.1
	Minimum	4.3	0.10	0.011	0.27	<0.001	0.13	2.5	0.8
AZ91	Maximum	10.2	0.32	0.014	0.35	0.004	0.60	0.84	17.8
	Minimum	8.6	0.08	0.001	0.18	0.001	0.04	0.63	0.8
	Average	9.4	0.21	0.005	0.26	0.002	0.20	0.72	5.4

ings on each plane. A casual glance at the table, as well as a study of only one plane, can lead to quite erroneous conclusions. For example, the Messerschmitt castings show that only a few are heat-treated, while the Junkers castings show that a considerable portion are heat-treated. The high percentage of castings used in the as-cast condition should be noted.

The chemical composition of the castings examined are shown in Table 3. Only the maximum, minimum, and average value for each group is given. The major alloying constituents—aluminum, manganese, and zinc—are in the normal range for each alloy. In some cases the manganese is somewhat below the minimum normally used. The copper content in some cases appears to be excessive; at least, it is above normal American practice. The nickel content occasionally is high. The silicon content is normal for casting alloys.

Alloy AZG

Since the casting field is quite involved it appears best to discuss first each alloy by itself. According to German literature Elektron alloy AZG (6 Al, 3 Zn) is the popular alloy used. The American equivalent is Dowmetal H. German practice is never to heat-treat this alloy. This is contrary to American practice where most castings are heat-treated to get increased ductility, toughness, and ultimate tensile strength and where many, particularly engine parts, are heat-treated and aged for maximum yield strength and stability.

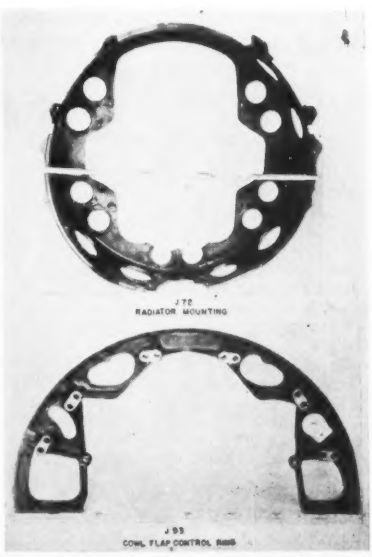

FIG. 1.

In the illustrations, for purposes of identification, the letter J will indicate the part that was from the Junkers and the letter M will designate the Messerschmitt.

Figs. 1 and 2 show castings of Elektron AZG (Dowmetal H). All parts are in the as-cast condition.

Fig. 1 shows the upper ring for the cowl flap control (J93). This ring holds the sprocket mechanism for operating the flaps. The radiator mounting (J72) is used to mount the engine liquid-cooling radiators. Both of these are fairly large in size, measuring about 4 ft. across.

Fig. 2 shows some miscellaneous castings in as-cast AZG. The supercharger parts J305, J306, and J314 are of interest. Note that the housing is cast integral with the valve housing. This same part on the Messerschmitt was cast in two pieces and a heat-treated alloy A9v was used for the supercharger housing. The valve housing is shown

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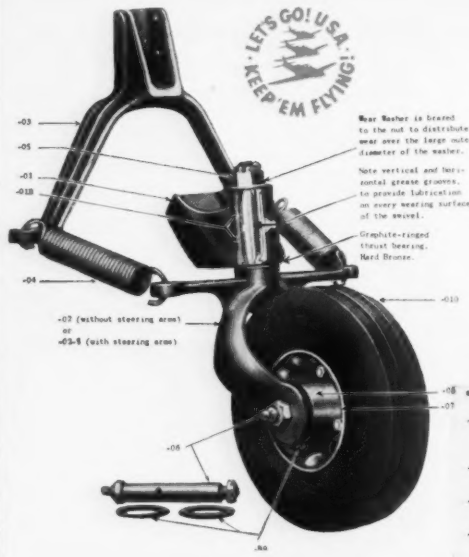
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-05
-01
-01B
-04
-02 (without steering arm) or -02-S (with steering arm)
-06
-07
-08
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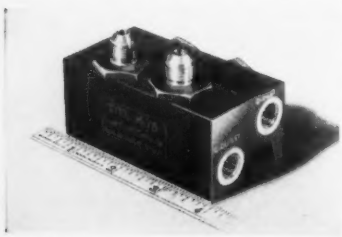

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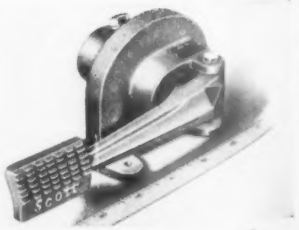

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here (M16B) cast of AZG, while the butterfly valve was of A9 alloy. The camshaft bearing (M11A) is of considerable interest since the camshaft operated directly in this casting. This design of bearings was used as the end bearings on the camshaft. Typical covers (J321-J322) are shown containing inserts. The heater control valve (J24) is interesting in that the valve (J24a) was of Elektron AZG, while the end plates (J24b) and (J24c) are of Elektron A9 (8½ Al, ½ Zn) as-cast. One air-frame casting J45 is included.

FIG. 2.

Alloys A9 and A10

The alloy that was used for 50 per cent of the castings on both planes was Elektron A9 (8½ Al, ½ Zn). There is no equivalent casting alloy used in this country, but a similar composition is used for extrusions and forgings known as Dowmetal O. The German practice, according to the literature, is to use this alloy in the heat-treated or heat-treated and aged condition for stressed applications. It is interesting to note that in actual practice many of these castings were used in the as-cast condition. Figs. 3–5 show some of these castings which, however, do not appear to come in the class of stressed parts. One explanation is that the foundry that produced the parts was equipped to produce Elektron A9v castings and, since heat-treatment was not required, it was omitted. This seems plausible since the parts could as well have been made of Elektron AZG alloy (6 Al, 3 Zn).

Fig. 3 shows the oil sump assembly (M17A) and the several parts that it includes. The sump (M17A) is made of AZG alloy, while the other parts are of A9 alloy. Parts 17C and 17D were cast chilled at the bearing surfaces. The cooling water pump shown in the assembly is an aluminum casting.

The fuel pump assembly (M20) and parts are shown in Fig. 4. Part M20D was of alloy AZG while the balance were of alloy A9.

The starter assembly (M19) shown in Fig. 5 was made of several housings—M19A and M19B of alloy A10—while M19C and M19D were of alloy A9. Two interesting but small castings of A9 alloy are the camshaft support bearing (M10A and M10B) also shown in Fig. 5. It will be remembered that a similar part was shown as one piece in Fig. 2 (M11A) where the alloy used was Elektron AZG. Quite a number were used for the camshaft support. Note the serrations on both pieces. These could be used for alignment or to prevent fretting. Other applications of this idea were used on the Messerschmitt. The oil sump cover (M18A) supports the oil strainer in part (M17A), Fig. 3, and was made of A10 alloy.

No logical reason can be found for the selection of alloys A9 or A10 in the as-cast conditions in place of alloy AZG other than that suggested above.

Alloy A9v

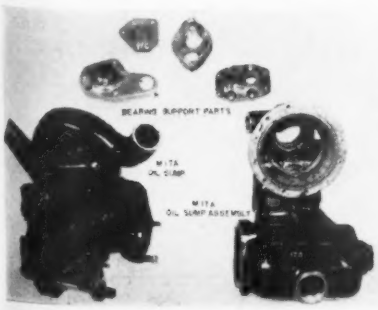
The most important group of castings examined were those coming in the class of stressed parts. The alloy used was Elektron A9v (8½ Al, ½ Zn heat-treated). This alloy has increased ductility, toughness, and tensile strength. Castings of A9v alloy are shown in Figs. 6–12.

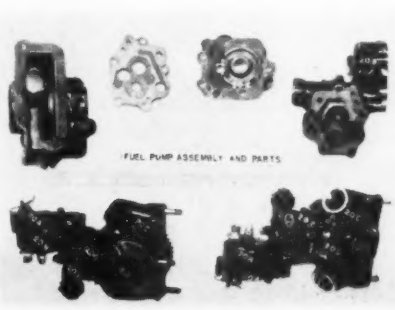
Fig. 6 shows several interesting castings: the accessory drive housing (M15A), the propeller reduction gear housing (M21A), and the supercharger housing (M16A). The supercharger housing in this case is made of Elektron A9v, while the same part on the Junkers was made of Elektron AZG as-cast (see Fig. 2 (J305)). The design is also somewhat different. The valve housing (M16B) has already been discussed as an AZG casting. The impeller is aluminum alloy.

Fig. 7 shows the landing wheels (J110) and (M24A), the oleo supporting casting (J115), and the trunnion casting (J120). These castings are of fairly large size and were all heat-treated alloy A9v.

Fig. 8 shows a group of castings—J327, J328, and J330 from the Jumo engine—while the balance are Junkers air-frame or miscellaneous castings. Fig. 9 shows a number of A9v air-frame castings from the Junkers plane.

Fig. 10 shows a group of A9v castings used as fuel tank supports. Note the many different designs.





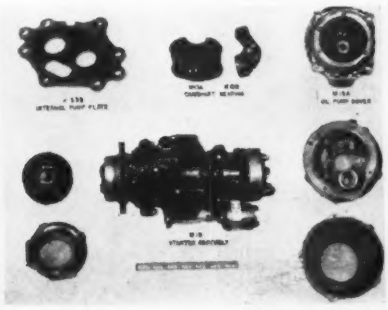


FIG. 3 (*left*). FIG. 4 (*middle*). FIG. 5 (*right*).

THE NAVIGATOR sights carefully, then speaks to his assistant below. It's the final fix and the lines on the dimly lit chart now converge —at Turin! They're over, and seconds later—"TARGET!"

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The same may be said, we believe, of all electrical and navigational equipment that we are privileged to produce for the Army Air Forces.

Landmarks of the sky say **"TARGET!"**

The W.W. **BOES** *Company, Dayton, Ohio*

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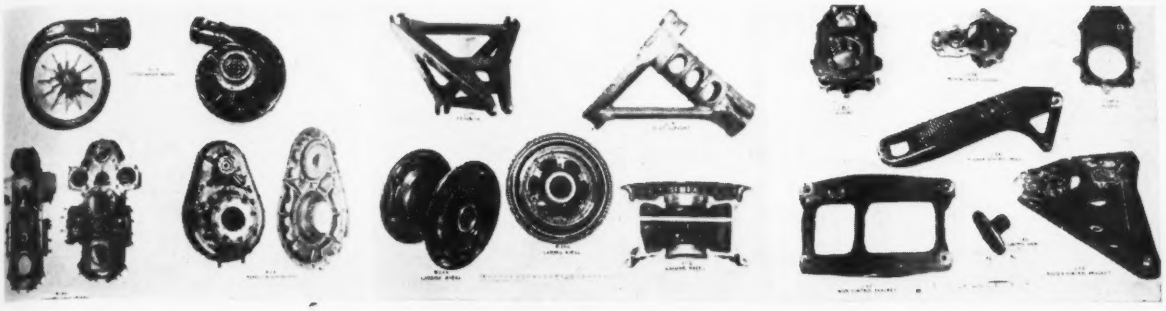


FIG. 6 (*left*). FIG. 7 (*middle*). FIG. 8 (*right*).

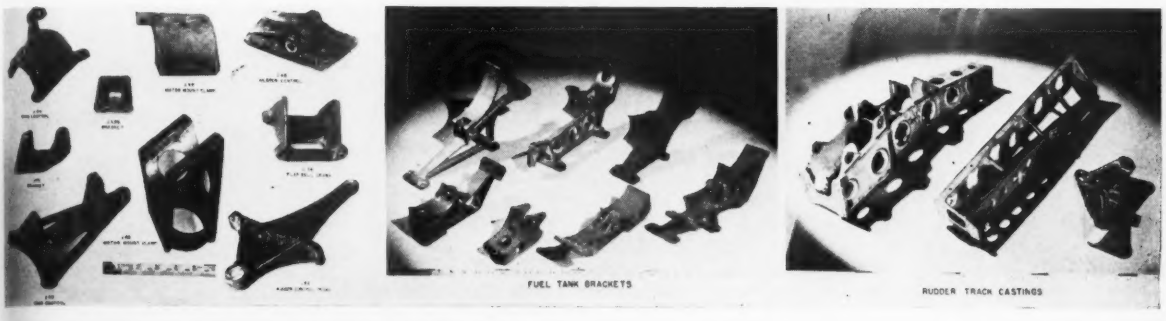


FIG. 9 (*left*). FIG. 10 (*middle*). FIG. 11 (*right*).

Fig. 11 shows the rudder track castings and Fig. 14 shows several other airframe castings. The aileron counterbalance assembly and parts are shown in the upper left of Fig. 12. The spider (J52) is a forging, while the other two parts (J50 and J51) are A9v castings. The bell crank (J102), the bracket (J103), and the dive brake (J54) are A9v castings. The only application of a heat-treated and aged casting found on the planes is shown in Fig. 12. The pilot seat base (J35) was made of A9h. It is not known what prompted the selection of an aged alloy for this application.

Alloy A231

A considerable number of castings were found of Elektron alloy AZ31 (3 Al, 1 Zn). A group of these castings are shown in Figs. 13–15. This alloy is not normally used in this country for castings. The American equivalent composition is Dowmetal FS, which is used for extrusions and sheet. The castings observed were usually of small size and simple design, although a few

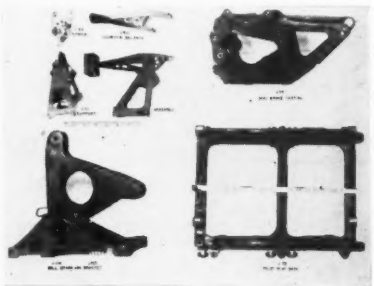


FIG. 12.

parts were rather complicated and of fair size. In general, this alloy has lower mechanical properties and poor foundry characteristics but has a decreased tendency to micro shrinkage with the result of better pressure tightness. It was probably with this quality in mind that the alloy was selected.

Alloy AFZ

Only two castings were found of Elektron alloy AZF and one of these is shown in Fig. 16. This is the leading edge of the fin (M23A). The other application is the pilot seat pedestal (M57D) Fig. 26. There is no equivalent American alloy being cast at the present time. The alloy is not heat-treated.

Soundness

Radiographic examination of the castings showed the quality to be generally good. Some castings, however, did show an excessive amount of microporosity. A varying degree of

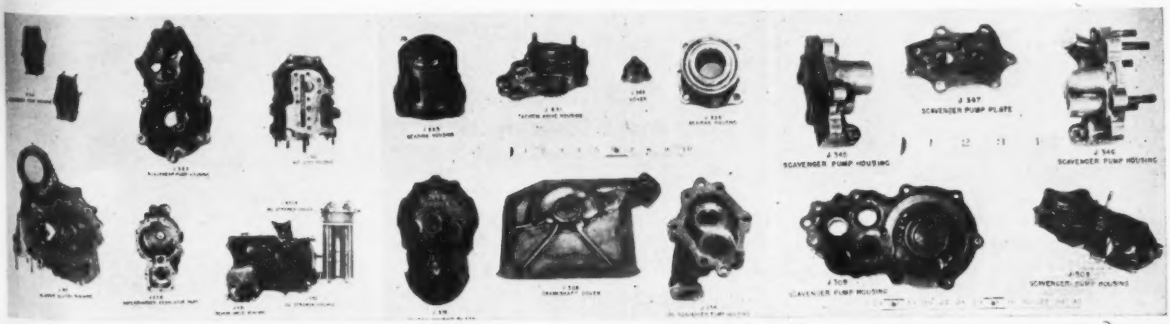
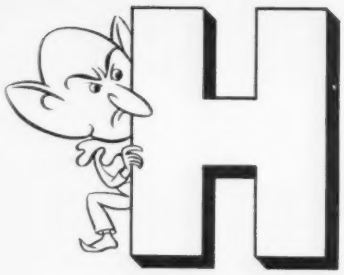


FIG. 13 (*left*). FIG. 14 (*middle*). FIG. 15 (*right*).



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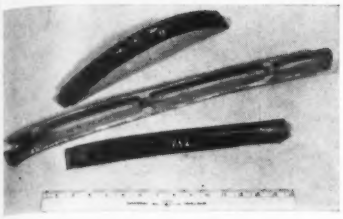

FIG. 16. M23A. Leading edge of fin.

porosity was observed for the different alloys, Elektron AZG showing the greater amount; A9 and A10, a lesser amount; and AZ31, the least. This is in accordance with published data.

A study of a number of castings showed that attention was paid to getting the critical or stressed areas in castings sound. This can only be accomplished by close cooperation between designer and foundryman. In the landing wheels (J110 and M24A, Fig. 7) the tire flanges were sound while some of the ribs showed slight porosity. The porosity in areas to be machined was also carefully controlled.

The surface of the castings was, in general, inferior to the surface of American castings.

DIE CASTINGS

The alloy used by the Germans for die castings (AZ91) is equivalent to the Dowmetal R. A group of die castings is shown in Fig. 17.

The composition of the die castings is shown in Table 3. The alloying elements—aluminum, manganese, and zinc—are normal for this alloy. Copper and nickel in some cases were high according to American standards.

Radiographic examination of the die castings revealed that they were quite sound and, in general, less porosity was observed than in similar American die castings. On the other hand, the surface appearance of the German die castings was inferior to American standards. Several of the die casting would be rejected by American inspectors.

FIG. 17.

TABLE 4

Average Mechanical Properties of Castings

Alloy	Ultimate Strength, Lbs./Sq.In.	Yield Strength, Lbs./Sq.In.	Elongation, % in 2 In.	Compression Yield Strength, Lbs./Sq.In.	Brinell Hardness Number
AZG	22,500	13,800	2.0	13,700	50.2
A9	21,200	15,700	2.0	.....	53.9
A9v	28,000	14,100	5.5	.....	52.6
A9h	26,100	18,300	1.0	.....	67.6
AZ31	24,600	9,900	6.7	9,500	42.0
AZF	15,300	9,300	1.0	.....	41.0

CORROSION

Practically no corrosion was observed on the parts from the Messerschmitt plane. In the case of the Junkers plane practically no corrosion was observed on the engine parts. In the case of the air-frame castings on the Junkers plane, some slight corrosion was noted. This was observed on areas either with no protection or where the protection was poor.

The basic corrosion resistance of the parts examined was determined by testing ground specimens in 3 per cent NaCl solution using the alternate immersion method. The time of testing varied from one to four weeks depending on the resistance of the specimen.

Table 3 gives the basic corrosion resistance of the metal in the various parts expressed as a corrosion rate in milligrams per square centimeter per day.

These corrosion rates are what would be normally expected from the analysis of the metal, since the basic corrosion rate is determined mainly by the composition. The basic corrosion behavior can be materially improved by a control of the impurities to established minimums.

In spite of the fact that the basic corrosion resistance was not good the parts showed a good service record for the conditions of use.

Some galvanic corrosion due to contact with dissimilar metals was observed on the Junkers air-frame castings. This, however, was not severe and was probably due to the poor protection afforded.

It can be said that no serious corrosion was observed on any of the magnesium castings examined.

SURFACE TREATMENT

Only one chemical treatment was used by the Germans. This treatment corresponds to the Chrome-Pickle used in this country and was usually applied before machining. Some of the parts, however, were treated after machining.

PAINTING

The paint coatings used on the parts varied over a wide latitude. On the Messerschmitt castings at least five different kinds of primers were used. In the case of the Junkers air-frame castings more uniformity in the primer was observed. The primer, in this case, was believed to contain chrome oxide as the inhibiting agent, with the possible addition of some zinc yellow.

In general, the paint adhesion was poor. Many cases were observed where apparently the paint was not oil resistant, with the result of poor adhesion. The coatings usually were quite brittle. It can be concluded that the painting practice of the Germans is below acceptable American standards.

METALLOGRAPHY

The microstructures of the castings were normal, with grain size about the same as observed in American practice. The heat-treatment was usually good as indicated by solution of the magnesium-aluminum compound. Some castings showed the presence of compound, but this was usually not excessive. A considerable number of castings exhibited burning during heat-treatment. This is reflected in reduced mechanical properties and is evidence of poor heat-treating practice.

PROPERTIES

Mechanical properties were determined on the castings where it was possible to machine test bars. The average results obtained are shown in Table 4. The average values given in the table are below minimum values for separately cast test bars as published in German literature. The minimum values for mechanical properties of bars cut from castings are 75 per cent of the values for separately cast bars.

WROUGHT PRODUCTS

Some interesting applications of wrought magnesium alloys were found in these planes. For greater clarity,

TABLE 5
Composition of Wrought Products

Alloy	Condition		Al	Cu	Fe	Mn	Ni	Si	Zn	Corrosion Rate, Mg./Sq.Cm./Day
AM503	Forgings		0.03	0.01	0.007	1.7	<0.001	<0.01	0.001	0.3
AZM	Forgings	Maximum	7.5	0.12	0.026	0.27	0.006	0.10	1.10	44.5
		Minimum	6.0	0.01	0.005	0.08	<0.01	<0.01	0.76	1.0
		Average	6.5	0.04	0.011	0.13	0.0015	0.03	0.84	16.4
AZ855	Forgings	Maximum	8.5	0.01	0.016	0.21	0.001	0.01	0.31	32.0
		Minimum	7.1	<0.01	0.001	0.11	<0.001	0.01	0.30	0.3
		Average	7.7	0.01	0.011	0.15	0.001	0.01	0.31	14.1
AM503	Sheet	Maximum	0.08	0.02	0.020	2.4	0.018	....	0.14	5.7
		Minimum	0.01	<0.01	<0.001	1.7	<0.001	<0.01	<0.001	0.4
		Average	0.03	0.01	0.010	2.2	0.003	0.01	0.04	1.7
AM503	Plate	Average of 2	0.03	0.01	0.13	1.6	<0.001	<0.01	<0.001	0.7
AM503	Extrusion	Maximum	0.03	<0.01	0.014	2.6				1.6
		Minimum	0.03	<0.01	0.008	1.8	<0.001	<0.01	0.001	0.4
		Average	0.03	<0.01	0.011	2.3	<0.001	<0.01	<0.001	1.0
AZM	Extrusion	Maximum	6.1	0.07	0.014	0.35		0.06	0.95	7.3
		Minimum	5.6	0.01	0.006	0.10	<0.001	0.02	0.76	0.2
		Average	5.9	0.03	0.010	0.19	<0.001	0.03	0.91	2.2

these will be discussed separately as forging, sheet and plate, and extrusions.

The chemical composition of the wrought alloys used are shown in Table 5. The major alloying constituents—aluminum, manganese, and zinc—are in the normal range for each alloy. In general, the copper content is held to low limits. The nickel and iron content is not controlled to low limits as is American practice.

Forgings

The forging art has been developed to a high degree in Germany as evidenced by the parts examined. The applications of forgings are shown in Figs. 18–21. Three alloys were used: Elektron AZM, AZ855, and AM503 corresponding with Dowmetals J, O, and M, respectively. The first two alloys are used for press forging while AM503 is used for hammer forgings.

Fig. 18 shows the engine mount parts (M13) used on the Messerschmitt. The engine mount (M13A) is a large

FIG. 18.

forging about 4 ft. long while the strut (M13B) is somewhat smaller. The illustration does not accurately show

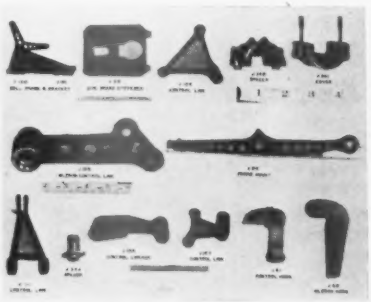

FIG. 19.

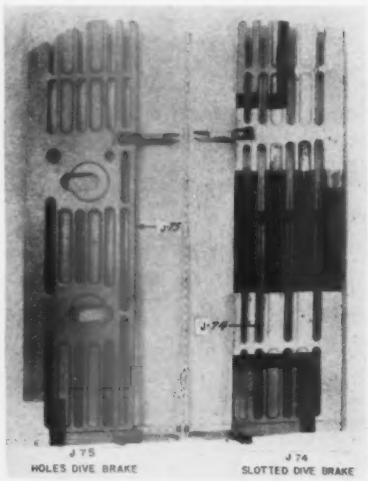

FIG. 20.

the comparative size of these forgings, since its purpose is to show design details as much as possible rather than

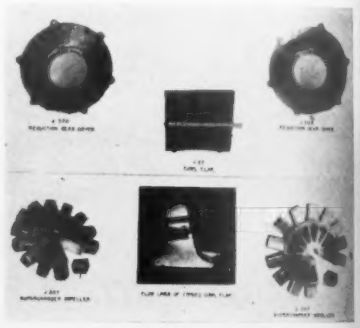

FIG. 21.

size contrasts. Elektron AZ855 corresponding closely to Dowmetal O was used for the engine mount, while the engine mount strut (M13B) was made of Elektron AZM alloy, which corresponds to the Dowmetal J. The other parts shown are M13C-AZ855, M14A-AZ855, and M14B-AZM. Part M14D was a casting of Elektron A9v.

A variety of forgings is shown in Fig. 21. Here again the size is not adequately illustrated, since the Junkers engine bearer (J84, Fig. 19) is almost 6 ft. long. All forgings shown are AZM alloy. The balance of the forgings are typical control parts. The bell crank bracket (J101) is an A9v casting.

The Junkers dive brakes (J74) and (J75) are shown in Fig. 20. These were also made of alloy AZM. Two designs were used on the plane as shown.

Fig. 21 shows several interesting forgings. The reduction gear cover (J303) is rather worthy of note. Observe the use of ribs to stiffen the entire section. The alloy is AZM. The cowl flap (J27) was hammer forged of AM503 alloy. This corresponds to the equivalent American alloy Dowmetal M. The macrograph showing flow lines

The B.F. Goodrich Airplane of the month

DOUGLAS DAUNTLESS

LIKE A DEADLY BIRD OF PREY, a Navy SBD screams out of space and hurls its 500-lb. egg on a victim below. Scratch another Jap!

That story was written in the Coral Sea . . . in the Gilberts . . . at Midway. This one carrier-based dive bomber, known as the "Dauntless," has been credited with sinking more combatant tonnage than any other plane in the Pacific. No wonder the Army adopted it too, calling it the A-24.

This month B. F. Goodrich, makers of Silvertown Tires, De-Icers, Bullet-Sealing Fuel Cells, and many other aviation products salutes the Douglas Dauntless—a great plane with a glorious fighting record!

In war or peace

B.F.Goodrich

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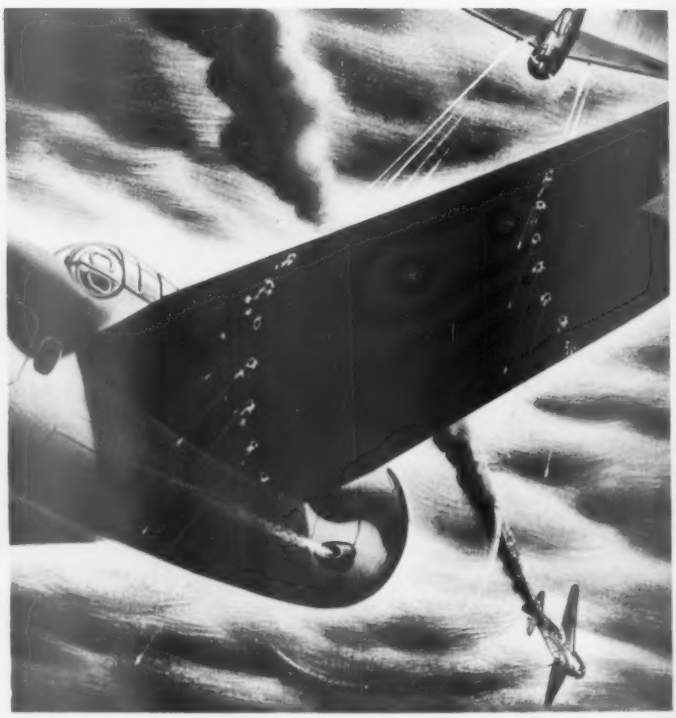

SO OUR FLIERS WILL NOT GO DOWN IN FLAMES

NO WONDER his mechanic whistled when he saw the fighter's wings. They looked like lacework. Neat rows of bullet holes crossed and quartered along them, stitched by a Zero's gunfire. Yet the pilot just hopped out, grinned, and went below to file his report—"... one sure, two possibles."

The "one sure" had vanished in a sheet of flame after one burst. The "two possibles" had glided down on the sea after the last drop of fuel had run out through their riddled wings.

Chalk up one more lopsided American victory. And chalk up one more valuable American pilot and plane saved by bullet-sealing fuel cells. The Zeros didn't have them. His American plane did. Without them, he might have been a "flamer" too . . . he surely would have been forced down out of the fight. Instead, he was telling his fellow pilots how a Zero disintegrates when a burst strikes home, and three Japs were wherever Japs go after dying for the Emperor.

Right here is where morale is born and nourished . . . in incidents just like this one. These pilots don't take off haunted by that nightmare of flaming death which haunts the mind of every Jap pilot. Our men *know* their planes are built to take it as well as dish it out. They know their fuel tanks can be pierced by 30s, 50s, incendiaries, and cannon shells and still hold the gas to bring them home. Yes, bullet-sealing fuel cells mean peace of mind. They're one of the biggest reasons why our fliers dive in against terrific odds without flinching . . . and come home to tell the tale.

B. F. Goodrich makes many of the bullet-sealing fuel cells used in our warplanes. We have pioneered many of the developments in fuel-cell construction that have given our fliers an all-important edge on the Jap . . . developments that are helping to keep our fliers' morale highest in the world!

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Developed leak-proof tank insert . . . Produced first cells for 4-motor bombers . . . Developed synthetic rubber molded connections . . . Applied Seal-o-matic principle of sealing . . . Developed effective adhesives for use in fuel-cell constructions.

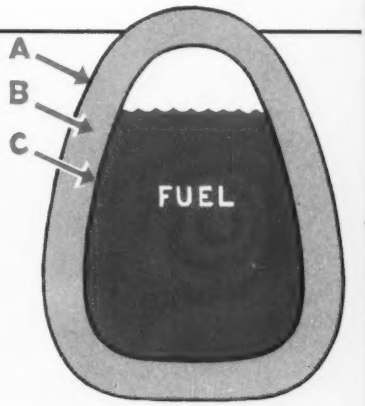
MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

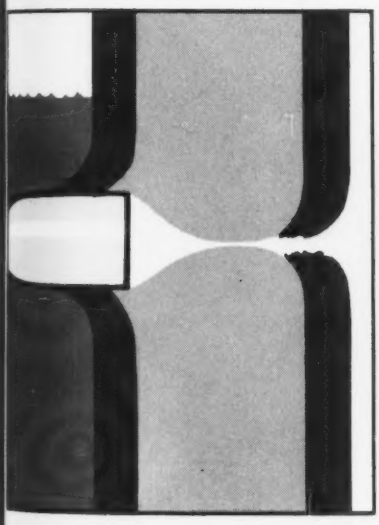
ARMY E NAVY

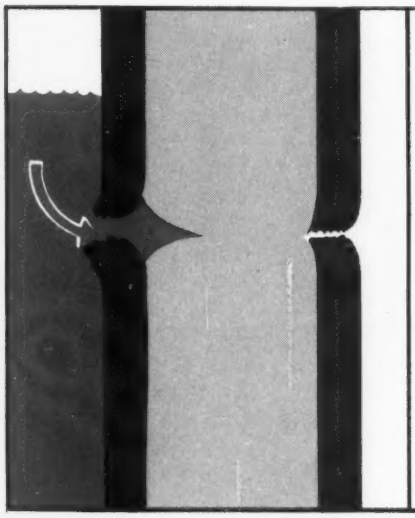
Why our planes can be shot through the heart

AND STILL KEEP ON FIGHTING!

A FEW BASIC PRINCIPLES will show how a bullet-sealing fuel cell functions. At the left is an actual fuel cell—one of the types used in our planes today. At right is a cross-section schematic sketch to show the main elements. (A) is the protective outer covering; (B) is a tacky, elastic material which actually does the sealing; (C) is the innerliner, which is resistant to gasoline and aromatic fuels, and prevents fuel from coming in contact with the sealant.







WHEN A BULLET strikes a fuel cell it passes through wall, as shown at left. The sealant—a highly elastic, tacky material—is pushed aside by the bullet. After the bullet passes through, the lips of the wound come back in contact by elastic retraction and stick together due to tack. If a perfect seal does not result immediately, fuel seeping in causes the sealant to swell and completes the seal. B. F. Goodrich was foremost in the development of this sealing method (called the Seal-o-matic principle)—now accepted as the most satisfactory.

THE TERRIFIC FORCE exerted on a fuel cell when a .50-calibre machine gun bullet strikes is demonstrated in this unusual photograph taken during firing tests. A bucket placed over the open filling vent was lifted to a height of 20 ft. on a solid column of gasoline. B. F. Goodrich fuel cells can be subjected to the force of many such hits without leaking.

In war or peace

B.F.Goodrich

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FUEL CELL QUI

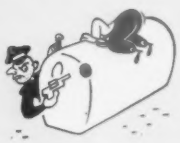
CAN YOU SCORE 100%?

There are ten true statements below on recommended maintenance procedure. Each statement is followed by three reasons why (a, b, c). Only *one* reason in each group is correct. Can you pick all ten correct ones?

1. Cells should be at least 50° F. before removal is attempted because . . .

a. Cells "freeze" to plane at lower temperatures.
b. "Vapor locks" develop at lower temperatures.
c. Synthetic rubber may crack if severely distorted at lower temperatures.

2. A man must always be stationed outside whenever another man is working inside a large fuel cell . . .



a. To watch out for spies.
b. To be ready to remove inside worker in case of emergency.
c. To give inside man friendly advice.

3. If gasoline has penetrated large area in sealing material, this area should be removed before repair because . . .

a. Gasoline will remain in sealant and may eventually injure cell beyond repair.
b. Gasoline-saturated sealant harbors gremlins.
c. If not removed, spontaneous combustion may cause explosion.

4. Patching should always be done in a dry place because . . .

a. Moist air causes fire damp.
b. Dampness or moisture makes good adhesion difficult.
c. Moisture rots sealant.

5. During drying process, puncture should be pried apart to . . .

a. Allow fuel in sealant to evaporate and prevent harmful absorption.
b. Discover hidden bullet fragments.
c. Find "true center" of puncture.

6. Cements should always be prepared immediately before using because . . .

a. Cement loses proper consistency rapidly due to vaporization of solvent.
b. You need different types of cement at certain hours of the day.
c. Cement absorbs moisture from the air.

7. When making a repair, fuel cell should be buffed thoroughly because . . .

a. Buffing warms up the surface.
b. Buffing smooths the surface.
c. Good adhesion cannot be obtained without buffing.

8. All buffed surfaces should be lightly washed with solvent because . . .

a. It loosens up the cell wall.
b. Small particles left by emery cloth would prevent proper adhesion of patch.
c. It primes the sealant.

9. Vapors of cements and solvents should not be allowed to accumulate in cell undergoing repair because . . .

a. Vapors are highly inflammable and might cause an explosion.
b. Vapors may damage cell interior.
c. Vapors cause patch failure.

10. Cells with interior repairs should be dried for 24 hours at 100° F. before fueling because . . .

a. This keeps water out of gasoline.
b. Cements need this thorough drying to prevent repair failure.
c. This preserves fuel's octane rating.

WHAT IS YOUR SCORE?

Each correct answer counts 10. 1-c, 2-b, 3-a, 4-b, 5-a, 6-a, 7-c, 8-b, 9-a, 10-b.

This is one of a series of maintenance quizzes prepared for ground crew trainees of the U. S. Army Air Forces Technical Training Command. It is our hope that this series will help all maintenance men get maximum service, safety, and efficiency from military, commercial, and civilian aviation equipment.

Skyway or Highway

B.F.Goodrich

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TABLE 6

Average Mechanical Properties of Forgings

Part No.	Name	Alloy	Tension: Ultimate Strength, Lbs./Sq.In.	Tension: Yield Strength, Lbs./Sq.In.	Tension: Elongation, % in 2 In.	Compression: Ultimate Strength, Lbs./Sq.In.	Compression: Yield Strength, Lbs./Sq.In.	Brinell Hardness Number	Shear Strength, Lbs./Sq.In.
M13A	Engine bearer	AZ855	45,500	29,700	12.5	60,000	19,500	56.4	19,400
M13B	Engine mount strut	AZM	41,300	26,500	9.5	58,300	18,000	54.3	18,700
J307	Supercharger impeller	AZM	47,700	33,200	16.5	.....	20,100	58.7	.....
J84	Engine bearer	AZM	47,000	33,100	13.3	60,500	23,500	57.6	.....
J74	Dive brake	AZM	47,600	32,600	14.7	61,500	21,800	56.0	.....
J27	Cowl flap	AM503	29,100	16,000	5.0	.....	.....	42.9	.....

TABLE 7

Average Mechanical Properties of Extrusions

Part No.	Name	Alloy	Tension: Ultimate Strength, Lbs./Sq.In.	Tension: Yield Strength, Lbs./Sq.In.	Tension: Elongation, % in 2 In.	Compression: Ultimate Strength, Lbs./Sq.In.	Compression: Yield Strength, Lbs./Sq.In.	Brinell Hardness Number
J92	Bomb rack side channel	AZM	46,000	35,000	13.2	62,100	22,500	57.2
J90	Bomb rack spacer block	AZM	34,100	11,600	20.0	.....	.....	49.5
J69	Nose frame	AM503	42,700	28,400	6.5	.....	.....	42.2

through a lug illustrates the good forging art of the Germans.

The supercharger impeller J307 is an unusual forging. This part was made by forging an extrusion and finishing by machining.

All of the forgings examined illustrate the good practice of the Germans. In many cases it was extremely difficult to develop the flow lines by etching because of the almost complete homogenization of the structure. The flow lines show good forging practice.

The mechanical properties of the forgings are shown in Table 6. Normally, the properties of AZ855 will be somewhat superior to alloy AZM. The latter alloy, however, is somewhat more easily forged. The properties of the forging will be dependent on working conditions such as temperature, amount of reduction, etc.

Extrusions

Few extrusions were found on the planes. An unusual application of extrusion is shown in Fig. 22. This is the Junkers nose frame (J69). The structure was fabricated by gas welding extrusions of alloy AM503, which corresponds to Dowmetal M. The macrographs show two welds, one of which has an insert adjacent. The structure was fabricated of AM503 because of its good gas welding characteristics. Table 7 gives the mechanical properties of the extrusions.

Several small bushings that were machined from AM503 extrusions are shown in Fig. 23. The side members of the bomb rack (J91 and J92) and the spacer block were made of Elektron AZM, which corresponds to Dow-

(*Continued on page 145*)

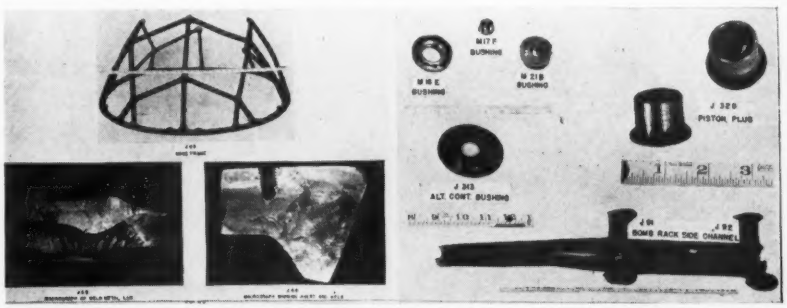

FIG. 22 (*left*). FIG. 23 (*right*).

TABLE 8

Average Mechanical Properties of Elektron AM503 Sheet

Name	Number	Ultimate Strength, Lbs./Sq.In.	Yield Strength, Lbs./Sq.In.	Elongation, % in 2 In.	Thickness
Gunner's seat	M57A	31,500	16,200	7.2	0.041
Inspection door	M56	32,100	18,000	13.2	0.039
Wing fairing	M54A	31,700	18,000	6.5	0.038
Switch box	M53	30,400	16,100	6.8	0.038
Cable shield	M52	31,900	19,200	13.0	0.038
Engine cowl fairing	J70	31,300	14,000	9.5	...
Bomb rack fairing	J94	30,200	13,700	8.5	...

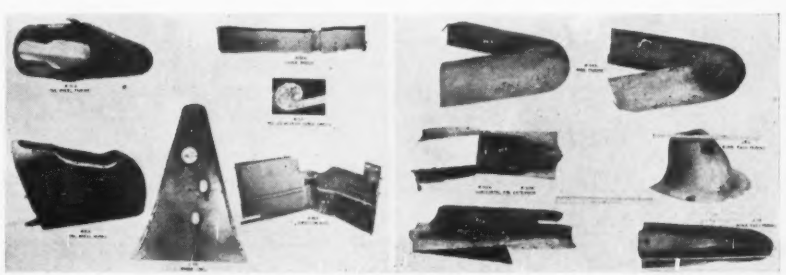

FIG. 24 (*left*). FIG. 25 (*right*).

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Perspective Illustration as Applied to Aircraft Design and Production

ARTHUR M. FITZPATRICK*

Consolidated Vultee Aircraft Corporation

SUMMARY

The present use of perspective illustration for supplementing and, in many cases, replacing conventional engineering drawing is described. The advantages to be obtained by use of such illustrations in all phases of aeronautical engineering, from the research, design, and development stages through production engineering, are discussed. Also discussed are the ways in which perspective illustration may prove of value in tool and fixture designing and, under the name of Production Illustration, the varied uses to which it may be put in the shop over and above the normal amount of engineering drawings. The personnel requirements for such work and the steps being taken to provide specialists in this field are described. A conclusion is reached regarding the effect of the introduction of perspective illustration in the technical field upon the procedures and practices of conveying scientific and engineering information, and an estimate is made regarding the extent to which this type of engineering drawing may establish itself in the technical and industrial world.

INTRODUCTION

THE ENTRY of the United States into the War brought an ever increasing demand for the designing and producing of new aircraft. Of primary importance in fulfilling this demand is the rapid dissemination of technical information not only from production engineers to the semiskilled or unskilled personnel in the factories but from engineers and technicians to others in the profession and between companies confronted by similar problems.

Under the impetus of this demand, perspective engineering illustrations emerged from comparative obscurity to a position of constantly increasing importance in the field of aeronautical engineering. Thanks to the fact that a picture is worth many words, the valuable time already saved by the substitution of one perspective sketch for pages of written words or the oftentimes complicated conventional engineering drawing has been multiplied many times, both in the preparation of the material and in interpreting and absorbing the desired information. In spite of, or even possibly because of, the rapid growth of the use of perspective illustration, its many uses are not generally understood by all persons or firms who might benefit by it. The following description of some of the various ways in which it may be used to advantage may serve to acquaint those not yet familar with it and to point out further uses to those who have utilized perspective illustrations to some extent.

Presented at the Aircraft Production Session, Eleventh Annual Meeting, I.Ae.S., New York, January 25–29, 1943.

*Director of Production Illustration and Perspective Engineering Drawing, Stinson Aircraft Division.

APPLICATIONS IN RESEARCH DESIGN AND DEVELOPMENT

The role that perspective drawings fulfill in the earliest design stages has generally been overlooked in favor of its more publicized part in helping to speed production in the industry's manufacturing plants. However, the importance of getting a new airplane out of the idea stage, onto the drawing boards, and into the air cannot be relegated to a place of secondary consideration.

Perspective drawings enter this phase of engineering at the beginning—around the design conference table. Here an idea may be placed on paper in the space of a few minutes in a form that may be readily understood by all. This facilitates discussion of the design problem, particularly where the conference includes members of functions and departments of the company other than engineering. Fig. 1 is an example of a preliminary design sketch showing a suggested method of accomplishing an antivibration mount between the fuselage structure and removable cowling. This sketch was prepared by an engineering illustrator working in collaboration with the designing engineer. The information from which this sketch was made consisted mainly of verbal description supplemented by the designer's own rough drawing.

As the design of the new airplane progresses, the graphic record in perspective plays an increasingly important part. By keeping a large cutaway perspective drawing of the design up to date, the work of the various groups is more closely coordinated. When using such a master perspective layout, many mistakes and difficulties become apparent at a time when making the required revisions in the design is a comparatively simple matter; whereas, were they to go unnoticed until a much later date, the subsequent changes and redesigning would mean a major delay.

Replacing the Engineering Drawing

The preceding description has dealt with perspective drawings as material of a supplementary nature rather than with the use of perspective for actually replacing the conventional engineering drawing. It has been satisfactorily demonstrated that it is not only possible to design a great many of the various components of an airplane in perspective but that it is faster and has, in several instances known to the author, proved to be more accurate. In one of these instances the complete electrical wiring system for an airplane was designed and laid out in the conventional manner—that is, in three flat views.

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When an attempt was made to transfer this information to a perspective installation drawing for the shop, it was discovered almost immediately that the original design was poorly conceived, being practically impossible to execute according to the layout. The poor design was due to the inherent limitations of the conventional orthographic drawing, which is difficult to use as a medium of visualization since it presents a picture the eye rarely sees. The final solution of the design was accomplished by working over a master perspective layout that presented a clear picture of the entire problem as it would normally appear to the eye when complete. The new design was done in an extremely short time compared to that spent on the original conception.

Perspective Sketches

The culmination of experimental design, the building of the prototype, can be greatly aided by the use of perspective sketches. These drawings (a large proportion of which are the original design sketches), by the simple expedient of adding the necessary dimensions and shop notes, become the actual working drawings for use in the experimental laboratory or shop. Fig. 2 illustrates the type of sketch, made during the design stage, which may be utilized by the experimental shop in making a mock-up or in the actual building of the prototype. This particular sketch was made during the designing of an airplane heating system, and the necessary information required to make a wooden mock-up for trial installation in the airplane was furnished in the quickest and clearest manner possible.

It is in this phase that the effect of conveying engineering information by perspective illustrations becomes apparent in the job of producing a finished article. In spite of the fact that the men engaged in such work are usually those of the highest caliber and the most experience, a considerable time-saving is accomplished when these drawings are used in the shop.

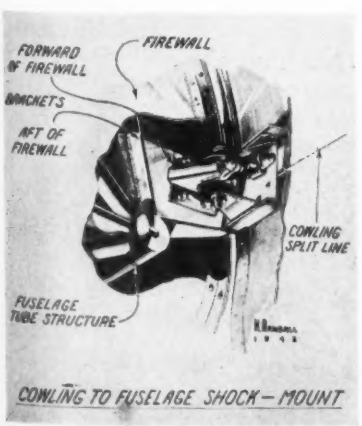


FIG. 1. Sketch showing method of presenting a proposed suggestion in the preliminary design stage.

PERSPECTIVE APPLIED TO PRODUCTION ENGINEERING

In the transition from experimental to production engineering, the existing perspective drawings done in the design stage are of great value in enabling the production group to become familiar with the new project. In the production engineering procedure now being followed by some companies, the information provided by the designers in the form of perspectives and original layouts is used in making the production layouts. This is done only to the point where the project engineer is satisfied with the practicability of the design and is then transferred to full-size layout form on metal and completed by this lofting process. The layout on metal then becomes the master guide to which all subsequent production designs are checked. Once an accurate and permanent layout is obtained, it is possible to make the production drawings in perspective as long as the indicated dimensions check with the master layout on metal. This holds true for all the various types of drawings required: installations, assemblies, subassemblies, and even details for the fabrication of parts. As was shown in Fig. 2, it is possible to supply all of the necessary dimensions, tolerances, angles, radiuses, etc., and any other information required for the proper fabrication of the part. It should be understood that it is not always necessary to furnish the shop with a mechanical drawing made accurately to scale. Any contention that this is not the case is disputed by the almost universal admonition: "Do not scale print."

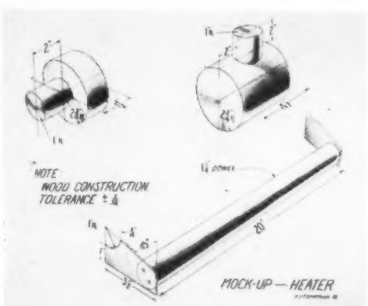


FIG. 2. A perspective sketch to be used as a working drawing in the experimental shop.

Normal Usage

Under normal circumstances it is possible to make almost 100 per cent of the installation, assembly, and subassembly drawings in perspective, as well as at least 50 per cent of the detail parts.

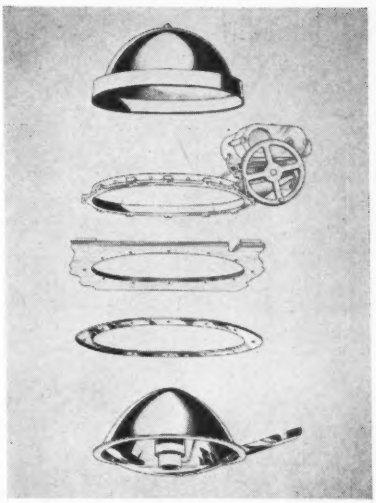


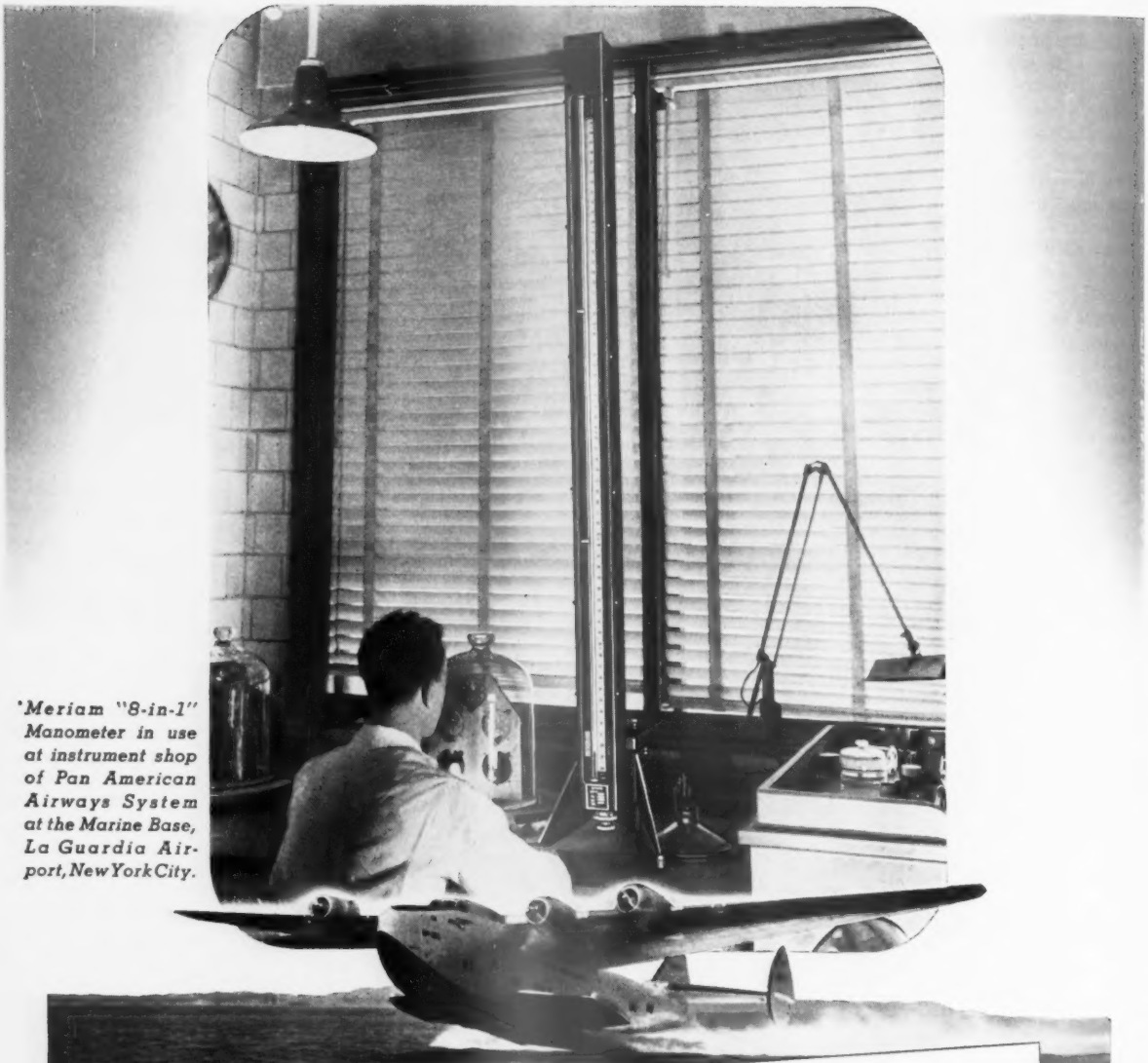
FIG. 3. Drawing showing the method of presenting an exploded view of an assembly or installation.

As examples of the advantages to be had in utilizing such a high percentage of perspective drawings, the following cases, observed by the author, will serve as illustrations:

In the making of assembly drawings for engine cowling panels, it was found that after doing the side and bottom cowl panel drawings in the conventional manner a saving of 75 hours of engineering time over either of the previous two drawings was realized when the top cowl panel was done in perspective. It is interesting to note that the member of the perspective group who made the drawing was a girl, a former commercial artist with two months' experience in this field.

The second example is the comparison of the two days required by an experienced draftsman to draw a control column boot assembly to the one day required to do two like drawings of similar boots by a member of the perspective group.

Fig. 3 shows an example of the type of drawing that may be used in production engineering illustration. This drawing shows the position and sequence of assembling and installing a landing light. Because of wartime restrictions, all part numbers and written information have been deleted, since such information pertains to military aircraft currently in production. In its original form, however, this drawing shows all the necessary information as to the location of the assembly, plus the attaching bolts, nuts, etc., required for completing the installation.



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The engineering illustrations simplify the task of those engaged in the designing of the tools, jigs, and fixtures and the planning of the assembly lines. The use of perspective may also be applied in the actual designing of the tools and jigs for production, as was done in the design stage of the airplane itself.

The production engineering drawings that are done in perspective also prove of immense value to the many subcontractors now working on aircraft production, many of them for the first time. Here the time- and laborsaving is repeated all through the process of tooling and production planning into actual production.

Service and Maintenance Uses

One of the major considerations in the production engineering of aircraft today is that of keeping the airplane easy to service and maintain in the field. Many perspective illustrations supplement the technical information concerning the operation, servicing and maintenance, and the overhaul and repair of the aircraft furnished the armed forces by the engineering staff. The importance of these illustrations is attested to by the emphasis placed upon the specifications governing such work. These specifications have been constantly revised by the service sections of our armed forces until, at present, they require the highest quality of perspective illustration, their problem being every bit as great as that of the manufacturer's, inasmuch as they too are trying to make skilled mechanics out of men with little or no previous experience. Fig. 4 contains a group of drawings pertaining to the installation of engine cowling. This sketch was prepared as illustrative material for maintenance instructions but shows the general method of enlarging exploded detail views, where required, for the purpose of supplementing the larger drawing by clarifying the methods of attachment. As in the case of Fig. 3, all written information has been deleted.

Standardization Drawings

Another place where perspective sketches have proved extremely useful in the engineering department is in work being done in cooperation with various standards committees, using quick sketches giving suggestions on the proposed standardization of such items as oil coolers, heating systems, etc.

Production Illustration

In production illustration the primary purpose is to convey the necessary information as clearly and as simply as possible to show the operation to be performed or the method of assembling or installing a component part. The average worker, unskilled in the interpretation of the conventional engineering print, can understand almost at once how he, or she, as is often the case today, is to perform his task and how it will look when properly completed. This type of illustration is applicable where high production is the foremost problem, since its function is to lower the time required by inexperienced personnel to become familiar with their jobs.

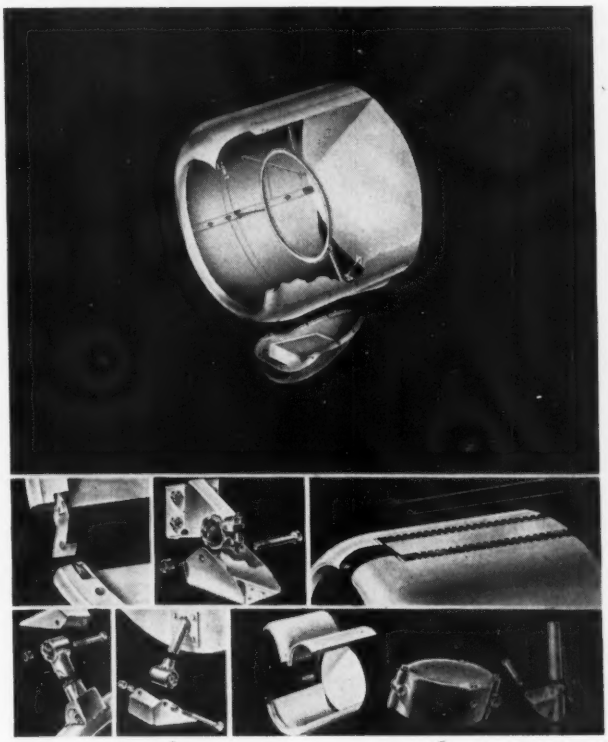

Fig. 4. Group of drawings giving detailed information required for the assembly and the installation, or removal of engine cowling.

Supplementary Aids

One example of this type of work is referred to as an "Illustrated Job Ticket." This is a small sheet, usually no larger than 11 by 14 in., bearing written instructions on the procedure to be followed in performing the operation (such as a small assembly, a bill of material of the parts required, and an exploded view), in the form of a perspective sketch, of the method of assembly.

These drawings seldom replace engineering drawings but are used to supplement them and to provide information desired in the factory but not usually furnished in the present engineering procedure. Among the many ways in which drawings of this type may be used in the shop is that of conveying technical information from such groups as the stress and materials departments. An example of this is a large perspective drawing of a welded structure bearing instructions for the preheating and postheating of specific joints. In addition to indicating the locations to receive such treatment, description is made of temperature indications for the various stages of heating, along with similar information usually contained in material and process reports and bulletins.

It has been the author's experience that, once started in an engineering department and put to work in the shop, the uses to which it can be put tend to multiply rapidly as their advantages become apparent, with new suggestions for their utilization coming from many different departments.

Personnel Requirements

As the use of perspective illustration increases, the problem of obtaining the type of personnel to perform this specialized work becomes worthy of serious consideration. It has been found much faster to train an artist to a point where he has a basic understanding of conventional engineering drawing than to spend the time and man power required to train the engineer and the experienced draftsman in the technique of perspective sketching. This proved to be only a temporary resort, however, since the artists most able to adapt themselves to the engineering field—those who had

(*Continued on page 33*)

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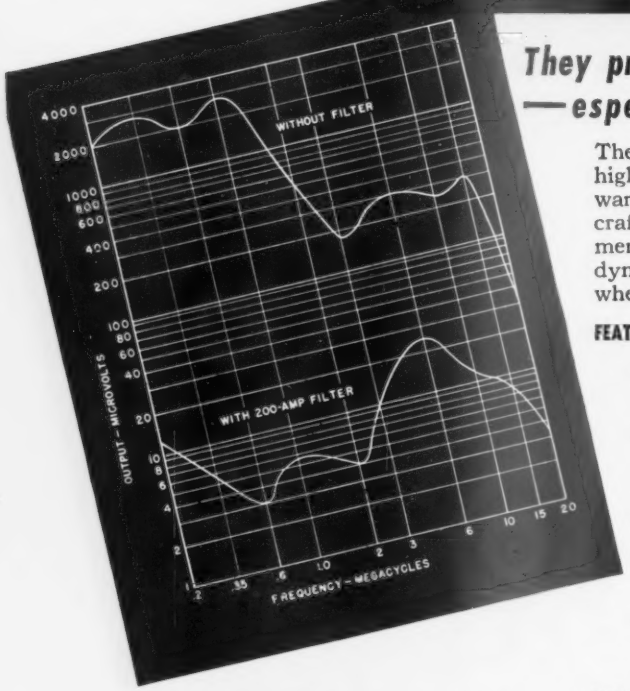

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Pressurizing Low-Altitude Airplanes

CHARLES W. MORRIS*

Airesearch Manufacturing Company

SUMMARY

In seeking future improvements in air-line facilities, a survey indicates that the greatest current objection to air travel is the changing air pressure that occurs when the airplane climbs or descends. It is proposed that the airplane cabin be pressurized to "sea-level" conditions or to airport altitude and include means for gradually changing the cabin pressure between airports located at different altitudes. Such improvements will eliminate the major causes of "plugged ears," earaches, stomach and intestinal gas, artificial sleepiness and dizziness in the air passengers.

In this discussion, the term "low altitude" is used to denote altitudes below 20,000 ft. The charts used in illustration are consequently proportioned to include only the range from sea level to 20,000 ft.

PRESSURE CABINS IN THE PAST

THE SUBJECT of pressurizing airplane cabins is, of course, not new. The advantages of pressurizing cabins have been cited in technical papers by numerous engineers. The commercial advantages of flying at altitudes up to approximately 17,000 ft. have been explored to a certain extent by two air lines using Boeing Stratoliner airplanes. In these studies and developments of pressure cabin airplanes, the principal attention has been given to:

(A) Increasing the number of completed flights by permitting the airplanes to fly above most storm conditions.

(B) Increasing the airplane cruising speed through its ability to fly at higher altitudes while maintaining the passengers at effectively lower altitudes.

(C) Increasing the percentage of smooth flights through the ability of the airplane to avoid a greater percentage of cloud formations.

Presented at the Air Transport Session, Eleventh Annual Meeting, I.Ae.S., New York, January 25–29, 1943.

* Chief Installation Engineer.

In this first venture the pressure cabin provisions were included so that the airplanes might operate at higher altitudes while maintaining an 8,000-ft. cabin level. The cabin altitude was the same as the airplane altitudes below 8,000 ft., and the rate of change of cabin pressure during ascent or descent was maintained at the nominal value of about 300 ft. per min. through pilot's concentration on airplane maneuvering procedure.

In looking to the future, the air transport industry expects tremendous increases in the amount of air passenger travel. These increases in passenger travel will result principally from the appeal that improved air transport facilities have for the traveler.

The airplane has gained its present prominent position in the passenger transportation field through its outstanding advantages in time economics. However, after this war is over, the air passenger transport business will increase in a manner directly commensurate with the degree to which it satisfies the needs and desires of those who travel for business or for pleasure.

OBJECTIONS TO UNPRESSURIZED AIR TRAVEL

In seeking knowledge of these needs and desires, the author has talked with a great many passengers in all modes of transportation and with executives and engineers in the aircraft industry. Some passengers who traveled once or possibly twice by air did not continue to travel by air because of the discomfort they felt as a result of the flight.

The principal objection to air travel, as stated by all of these groups, is the effect of pressure change that requires continuous swallowing and ear popping. A great many people have suffered violent earaches when they have been unable to accomplish a balancing of air pressure inside and outside of the eardrum. A number of prominent engineers had a definite distaste for air travel because the up and down of a long flight, with the accompanying pressure changes, produces tender eardrums, mental strain, and a fatiguing nervous tension.

A secondary objection to air travel is due to the low atmospheric pressure that prevails when the airplane flies at altitudes in excess of 8,000 ft. Some air routes require the airplane to fly at altitudes of 10,000 to 12,000 ft. in order to maintain sufficient clearance over mountain passes, mountain ranges, or peaks. Flying at these altitudes induces lowered mental activity, dopiness, sleepiness, and, in some passengers, dizziness. There have been some cases of heart trouble, but these have been the exception. The lowered air pressure also induces the formation of stomach and intestinal gases that are unpleasant and, on occasions, result in a somewhat polluted cabin atmosphere.

These detrimental effects of lowered air pressure must be overcome.

THE PRESSURE CHANGE PROBLEM

Fig. 1 gives the relationship of barometric pressure to altitude. It is noted that the slope of the barometric pressure curve changes with altitude, thus indicating that the rate of pressure change varies.

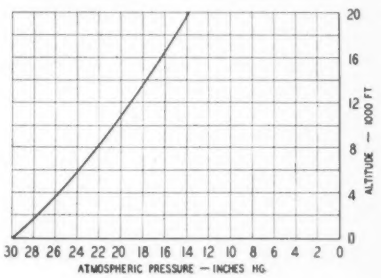

FIG. 1.

Fig. 2 shows that the rate of pressure change per 1,000 ft. altitude is greatest at sea level and decreases with increasing altitude. It will be noted that the rate of pressure change at 10,000 ft. altitude is only 73 per cent as great as at sea level. At 20,000 ft. altitude it is only 53 per cent of that of sea level.

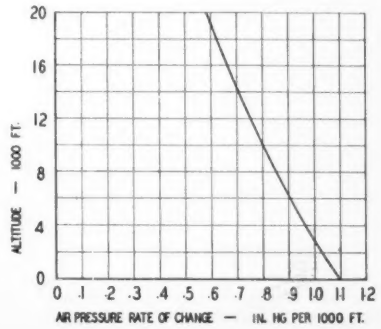

FIG. 2.

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This causes one to wish that it were possible to skip the lower altitudes and do climbing and descending in the low rate of pressure change region at higher altitudes. There appear to be possibilities of doing this, as will be shown further along in this paper.

Airport Level Cabin

It would be desirable to maintain a "sea-level cabin" regardless of flight altitude. Under such conditions the air traveler would be subjected to "living-room" pressure conditions rather than "mountain-peak" conditions.

In mountainous terrain it would not prove practical to attempt to maintain a sea-level cabin because the airports are frequently located at 4,000 to 6,000 ft. altitude. However, it appears feasible to provide a cabin that would be adjustable as to level. After take-off, the cabin level could be adjusted to the barometric pressure of the flight destination, and the rate of change could be adjusted to the required value so that the pressure change would be gradual over the period of the flight.

Current Operation

United Airlines has permitted the use of their route from San Francisco to Omaha as an example as shown in Fig. 3. The solid darkened area shows the terrain sectional contour of the radio beacon route, while the light outlines show the off-course peaks within 50 miles on either side of the route.

The light dashed lines show the approximate flight path of the unpressurized airplanes that fly this route at the present time. They must fly to nearly 10,000 ft. between San Francisco and Reno, to approximately 12,000 ft. between Reno and Salt Lake, and between 10,000 ft. and 11,000 ft. between Salt Lake and Cheyenne. It is obvious that the rate of change in altitude is necessarily rather great. The actual rate of change can obviously be kept low by flying the airplane at a low rate of ascent or descent, but this increases the flight time with accompanying increase in cost.

The required changes in pressure along this route are a pressure decrease of $4^1/_2$ lbs. per sq.in. while climbing from San Francisco and an increase of 2 lbs. per sq.in. while descending to Reno; a pressure decrease of 3 lbs. per sq.in while climbing from Reno and an increase of 3 lbs. per sq.in. while descending to Salt Lake City; a decrease of $2^1/_2$ lbs. climbing from Salt Lake City and an increase of 2 lbs. while descending to Cheyenne; a decrease of 1 lb. climbing from Cheyenne and an increase of $3^1/_2$ lbs. while descending to Omaha.

These pressure changes are practically unendurable for people who are suffering from colds or bad sinuses.

Operation of the Future

The greatest passenger comfort will be realized by keeping the total pressure change as low as possible and, at the same time, as gradual as possible. The white line, which appears to tunnel through the mountains, would be the route of cabin level which would produce greatest passenger comfort.

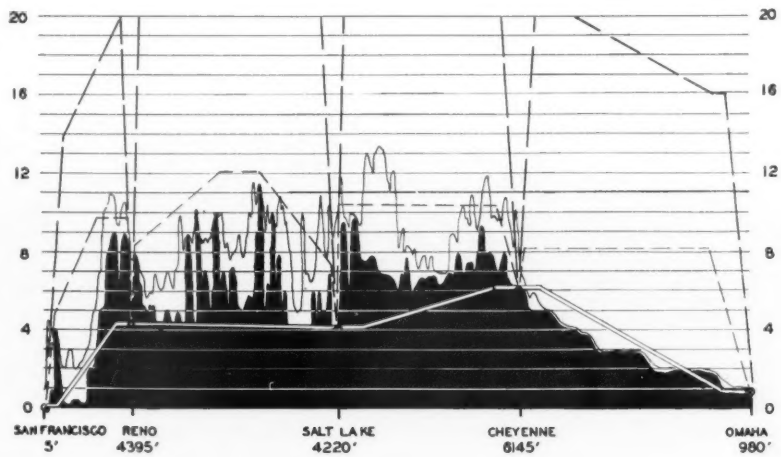


Fig. 3.

Just as the airplane is able to choose its own course over the surface of the earth for convenience and expedience, the pressure cabin permits the choice of cabin level, without regard to terrain, to give greater passenger comfort. The passengers are availed the use of theoretic tunnels through mountains and viaducts over valleys.

During the take-off and initial climb period, the cabin remains at sea-level pressure condition. The rate-of-change selector is then set at the value necessary to give the total change in cabin level required during the flight, and the cabin altitude limit is set to the Kollsman reading at the destination.

When the airplane takes off from San Francisco for a one-hour-and-20-min. flight, it can be assumed that the approximate time for the cabin altitude to make the change of 4,390 ft. will be about 60 min.; hence the required rate of change will be approximately 70 ft. per min. This will be far better than the present steep climb to 9,500 ft. to clear the mountain ridges and then descending quite abruptly to Reno.

From Reno to Salt Lake City the change in airport level is negligible—only 175 ft. Hence the cabin altitude would remain constant for this flight of approximately $2^1/_2$ hours, eliminating the previously mentioned pressure changes.

From Salt Lake City to Cheyenne the cabin altitude would have to increase at a rate of 20 ft. per min., while from Cheyenne to Omaha the cabin altitude would have to descend at a rate of 40 ft. per min.

The dark dashed lines show the altitudes to which the airplane may operate while maintaining the cabin altitude shown by the white line. In this sample case it is assumed the airplane cabin has been built to use a working pressure of 6 lbs. per sq.in. The airplane could then operate at 14,000 ft. while maintaining a sea-level cabin pressure.

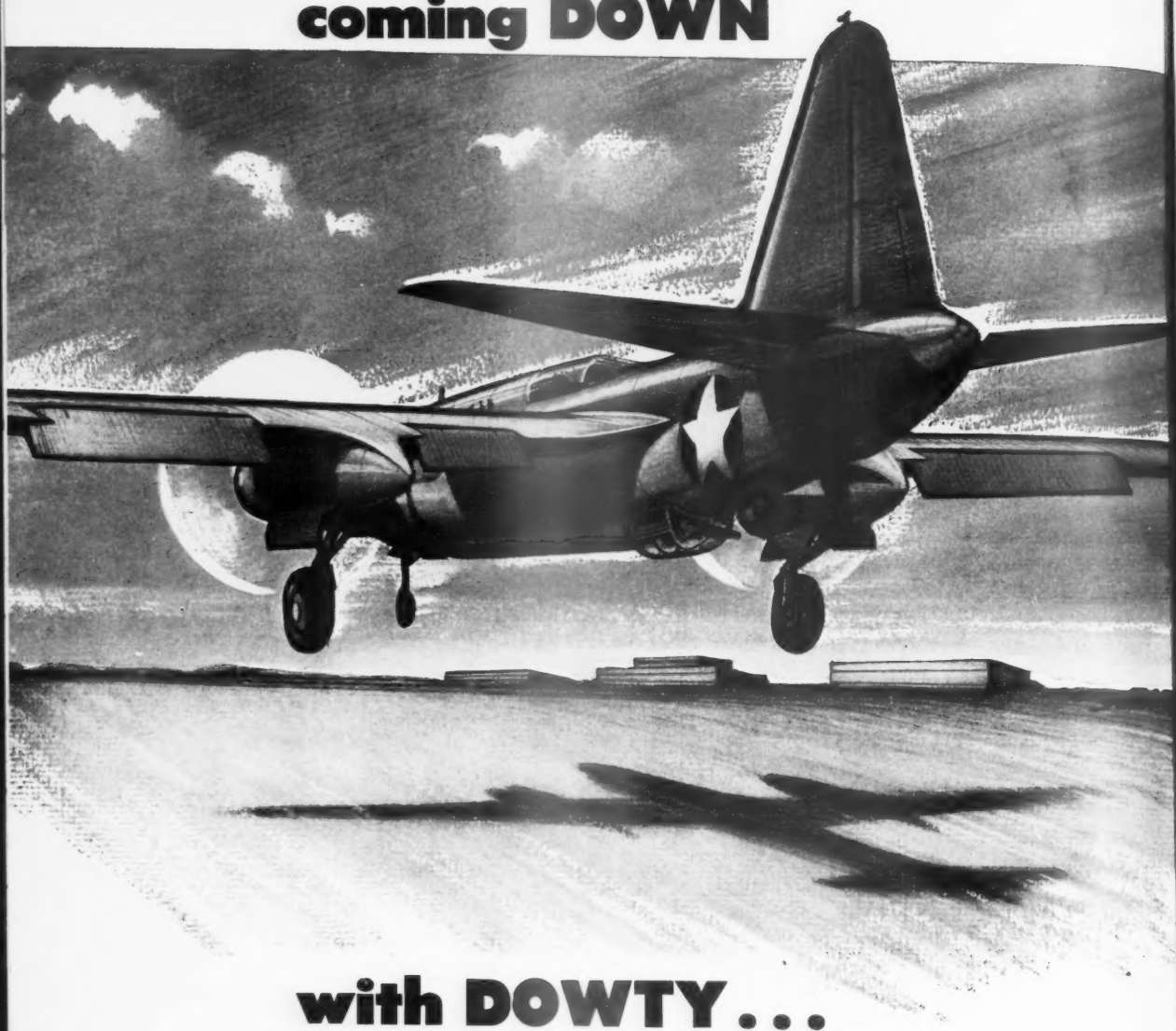
The airplane can fly sufficiently high to clear all obstructions and then make a rapid descent to the destination airport while the cabin is maintained at the airport pressure level.

Cabin Pressures

This cabin pressure performance range is shown in Fig. 4. The zero cabin pressure curve is merely the standard barometric pressure curve as shown in Fig. 1. The point at which these cabin-pressure curves cross the 30-in. Hg curve indicates the altitude at which the cabin may be maintained at sea-level pressure. With a 4 lb. per sq.in. cabin pressure, a sea-level cabin may be maintained to approximately 8,500 ft., while a 6 lb. per sq.in. pressure will maintain a sea-level cabin to approximately 14,000 ft. An 8 lb. per sq.in. cabin pressure would maintain a sea-level cabin to 20,000 ft. It appears probable that a 6 lb. per sq.in. cabin pressure may prove to be the practical limit for pressure cabins in the years to come.

In maintaining a cabin pressure to 6 lbs. per sq.in., we note that the rate of pressure change in the cabin at altitudes above 14,000 ft. is arithmetically the same as the change in barometric pressure in this same range. Hence the

The importance of coming DOWN



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low rate of pressure change that was noted in Fig. 2 is made available when a system is incorporated which maintains a sea-level cabin at the lower altitudes.

The Compressor Problem

The compressor problem is not a difficult one since the maximum required pressure ratio required of the compressor would be less than two (maintaining a 6 lb. per sq.in. cabin differential pressure while flying at 20,000 ft.). Over most of the country, where sea-level cabin is approximately maintained, the compressor pressure ratio will be less than 1.8 while the airplane is flying at 14,000 ft.

A rough approximation indicates that the compressor will require about ¾ hp. per passenger; hence a 100-passenger plane that provides 100 per cent stand-by air supply equipment would probably have two compressors, each of which would require approximately 75 hp. from the driving unit (presumably the aircraft engine).

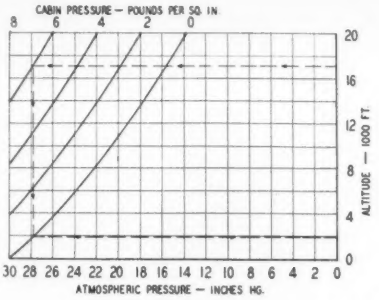
CABIN PRESSURE — POUNDS PER SQ. IN.
8 6 4 2 0
20 16 12 8 4 0
ALTITUDE — 1000 FT.
30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
ATMOSPHERIC PRESSURE — INCHES HG.

Fig. 4.

Temperature Control

Temperature conditioning of aircraft cabins has been one of the orphan installations along with the cabin ventilating system. Even with temperature conditioning of the quality now employed in transport airplanes, pressure conditioning in the manner described will prove to be the next great advancement in the popularization of air travel.

Heating of the cabin air during cold weather can undoubtedly be accomplished through utilization of the energy of compression. This has been proposed on many installations and has been utilized on the Stratoliner installation. Still better regulating means can be produced for controlling this heating to the desired amount.

There is the question of cooling the cabin air during warm weather operations. At some later date a paper will be presented covering this temperature conditioning phase of the cabin supercharging cycle.

(*Continued from page 27*)

had some training or experience along this line or who showed an aptitude for it by having mechanical inclinations, a good knowledge of perspective, and the ability to work accurately in detail—were soon absorbed into perspective engineering work. While these newcomers proved adequate in the general type of perspective work to be done, there are several places where more specialized training is desirable.

When working in the research or preliminary design groups, for instance, the illustrator should have a sound technical background, be thoroughly familiar with the problems involved, and be able to supply a sketch out of his own imagination, because the material he works with at this point consists almost entirely of verbal description and rough sketches. It is in the design stage where the ability of an engineer to use perspective to place an idea on paper is an invaluable asset. The author has had more than one engineer in a responsible position confide that he would give much to be able to convey his thoughts by means of a perspective sketch.

Personnel Training

It is apparent, then, that the ideal situation would be to have men with a technical education or background and engineers with training in the use of perspective do this type of work. Steps have been taken to provide suitable training for both. Available to artists who can qualify and to engineers who are interested, there are courses in perspective engineering drawing now being given in the engineering schools of some of the larger universities, sponsored by the Engineering, Science, and Management War Training Program of the United States Office of Education. After conducting these courses for a period of time, several of these universities are including classes in perspective as part of their regular engineering curriculum, some as electives and some to be required should the courses prove as successful as the ones given by the E.S.M.W.T.

Conclusion

With perspective illustration becoming firmly established in the engineering and industrial world and noting the recognition it has received by some of the major educational institutions, it is logical to hope that this method of transmitting engineering information will retain its place after the present conflict is ended. Like many another new idea or new material born of necessity during the emergency, it will prove to be more than a temporary substitute, since in so many cases, instead of merely supplementing it has supplanted the conventional method.

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The Horsepower Meter for Aircraft

J. C. LUTTRELL* AND W. A. PETRASEK†

Army Air Forces and American Air Lines, Inc.

ABSTRACT

The horsepower meter described in this paper answers the existing lack of suitable instrumentation for torquemeter operation of aircraft engines. The installation requires the addition of a small electrical multiplying unit out in the engine nacelle, one additional wire to the cockpit, and an a.c. rectifier type of voltmeter as an indicator. The existing tachometer generators are utilized and the existing feature of interchangeability of these generators is preserved.

An overall accuracy of brake horsepower indication of 3 per cent can be realized as well as a simplified method of power control which will help ease the load on the pilot.

INTRODUCTION

THE EVER INCREASING MAGNITUDES of engine horsepower ratings and the accompanying augmented fuel consumption have thrown the spotlight on improved methods of aircraft-engine operation. The existing method of "chart horsepower" operation has been analyzed and found basically too inaccurate to warrant further refinement of the associated instrumentation. The development of the torquemeter-equipped engine bears witness to the need for more accurate engine control.

OPERATION BY CHART HORSEPOWER

The chart horsepower method of engine operating consists, briefly, of the adjustment of two chosen parameters of engine horsepower output —namely, the manifold pressure and engine r.p.m. to conform with an empirical chart. This chart is obtained for each particular type of engine by running a series of land tests at the best power fuel-air mixtures in which the relation between the above parameter and engine horsepower, as measured on a dynamometer, is plotted. In addition to the manifold pressure and r.p.m., the effect of the barometric pressure or the pressure altitude of the engine and the temperature of the intake air are empirically investigated and the results listed in tabular or chart form to be applied as corrections to the basic horsepower obtained from the manifold pressure-r.p.m. curves drawn for engine operation under standard atmospheric conditions (see Fig. 1).

From the foregoing outline of chart horsepower operation, it is evident that four instruments must be consulted by the pilot before he can determine the actual horsepower being developed in his engine—namely, a manifold pressure gauge, an engine tachometer, a barometric altimeter, and an outside air temperature gauge. After obtaining the readings of each of these instruments, the pilot must then consult his "engine chart" to obtain the value of horsepower being developed.

An analysis of the method yields the following information:

Each of the four instruments consulted have instrument errors ranging from 0.5 to 5 per cent exclusive of the ever present errors in reading due to parallax. These errors, when applied to the engine chart, can result in an error of 5 per cent or more in the value of chart horsepower.

Additional errors not readily apparent are present, nevertheless, in the assumption that the particular engine under consideration will conform exactly to its empirical "engine horsepower chart." Such variables as the effect of changes in mixture, cylinder temperature, and humidity are not susceptible to accurate correlation with horsepower through instrumentation. Engine life and losses due to poor ignition, bad valves, etc., are known to result in a variation of as much as 10 per cent.

OPERATION BY TORQUEMETER

A new technique of operation which eliminates the necessity for making a number of corrections to observed readings and then guessing other corrections to determine actual horsepower involves the use of a torquemeter to read the torque developed at the propeller shaft in combination with the engine tachometer (see Fig. 2). From the standpoint of the pilot, the torquemeter is a great contribution, and, as we know, it is horsepower that flies an airplane, not manifold pressure. Thus, the torquemeter simplifies the power control problem. But here again we have problems of instrumentation.

Brake horsepower is computed as follows with a torquemeter-equipped engine: Torque pressure times r.p.m. divided by a constant. In order for a

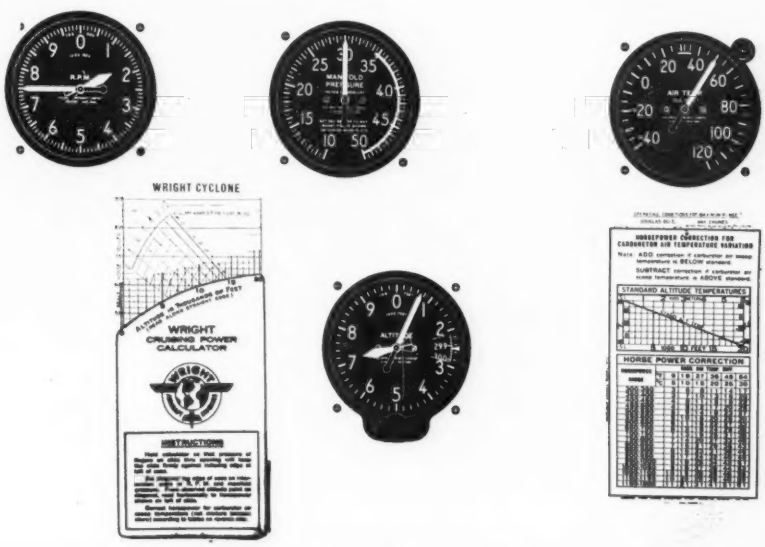

FIG. 1. Chart hp. instrumentation.

Presented at the Power Plants and Propellers Session, Eleventh Annual Meeting, I.Ae.S., New York, January 25–29, 1943.

*Chief Engineer, Matériel Project Section, Air Transport Command.

†Electrical Engineer.

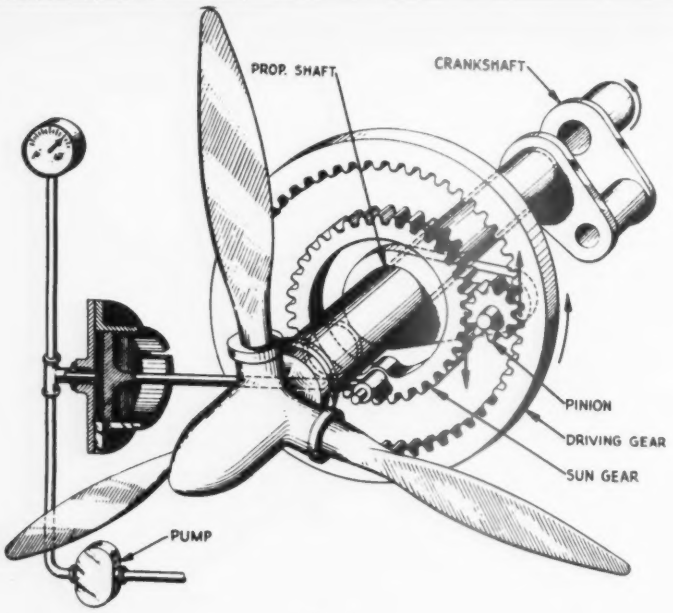

FIG. 2.

pilot to set his desired power, he must compute his torque pressure and then set the r.p.m. to a desired speed, open the throttles until the torquemeter indicator reads the desired calculated torque pressure, and, at the same time, adjust the mixture. The errors in this method are dependent upon the accuracy of the tachometer and torquemeter indications. The torque indication can be transmitted to the cockpit either by an oil-pressure line or an electrical remote indicating system. While the oil-pressure line method is accurate down to the pour-point temperature of the oil used, it is sluggish and, in multi-engined installations, the weight of the lines plus oil is considerable. This leaves only the remote electrical indicating system which is mechanically good with an accuracy at best of only 2½ to 3 per cent. This error, plus the tachometer error of 1 per cent, amounts to a total error of approximately 4 per cent.

OPERATION BY HORSEPOWER METER

Airplane-engine control may be simplified by the use of a direct reading brake horsepower meter. Furthermore, the technique of the brake horsepower meter, as described in this paper, in electrically combining torque output with engine speed makes possible an increase in the accuracy of the instrumentation. With a suitable direct reading brake horsepower meter, it would be only necessary for the pilot to set his horsepower and r.p.m. and lean the mixture to the minimum allowable. No empirical charts would have to be consulted or corrections for altitude and temperature made. Furthermore, inasmuch as the horsepower being measured is that which is actually being delivered by the engine, all the incalculable factors affect-

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ing engine horsepower are no longer of any consequence to the pilot, who is interested solely in the power being developed at the propeller. The elimination of the tachometer from the picture with its 1 per cent error is realized. This is particularly true of the horsepower meter in conjunction with a.c. tachometer installations of the frequency type (see Fig. 4).

The basic circuit necessary to combine electrically the torque output of an engine with the engine speed in order to calculate brake horsepower is broadly old, patents having been issued for horsepower circuits prior to the beginning of the present century. The circuit in Fig. 3 shows how the fundamental electrical equation, $I = E/R$, is adapted to an aircraft-engine installation.

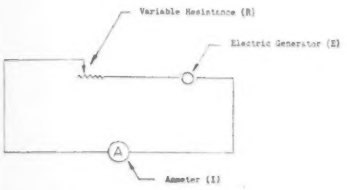

FIG. 3. D.c. hp. meter circuit.

Brake horsepower equation for engines with torquemeter attachments:

$$\frac{\text{torque pressure} \times \text{r.p.m.}}{\text{constant}} = \text{b.hp.} \qquad (1)$$

Equation for the electric circuit shown above:

$$I = E/R \qquad (2)$$

In the above electric circuit E is directly proportional to r.p.m. and R varies inversely with the torque pressure; therefore,

$$E \sim \text{r.p.m. and } R \sim \frac{1}{\text{torque pressure}} \qquad (3)$$

Substitute relationships (3) in (2):

$$I = \frac{E}{R} = \frac{\text{r.p.m.}}{(1/\text{torque pressure})} = \frac{\text{r.p.m.} \times \text{torque pressure}}{1 \text{ (or } K)}$$

Therefore,

$$I = \frac{\text{r.p.m.} \times \text{torque pressure}}{K} = \text{b.hp.}$$

The pressure from the torquemeter of the engine varies a resistance inversely as the pressure, said resistance being connected in series with the engine tachometer generator and an ammeter that is calibrated to read in units of brake horsepower. This combination is electrically sound but its practicability is limited from a maintenance standpoint because the variable resistance, tachometer generator, and ammeter have to be calibrated as a unit, making it impossible to change any one of the units on an airplane in a field without affecting the accuracy of the meter. The limitations of this type of horsepower meter may be compared with the limitations of the d.c. tachometer installation which depends upon the voltage stability of a magneto for its accuracy.

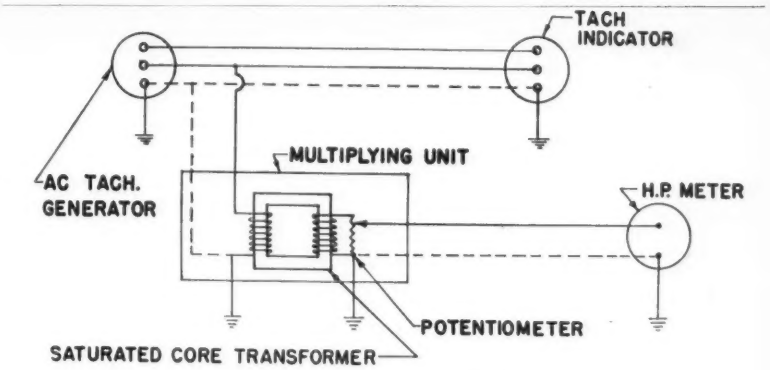

FIG. 4. A.c. hp. meter circuit.

The preferred a.c. brake horsepower meter is shown in Fig. 4. A typical two- or three-phase a.c. tachometer installation is installed. The output of any two of the existing tachometer generator wires is connected across the terminals of a saturated core transformer. The output of the transformer is applied to the fixed whole resistance of a potentiometer, the movable contact of which is controlled by engine torque. This potentiometer control device is preferably of the type that develops torque right up to the control point.

The operation of the meter is as follows: The output frequency of tachometer generator varies proportionately with engine speed. This proportional variation of frequency is transformed into a proportional voltage variation with speed by the saturated core transformer which is relatively undisturbed by small changes in generator output voltage. This fact alone makes it possible to replace tachometer generators without having to recalibrate the horsepower meter and permits the interchangeable use of various existing tachometer generators. The voltage variation which is proportional to engine speed is impressed across a potentiometer resistance, and a specific ratio of this voltage is impressed across an alternating current voltmeter suitably calibrated in brake horsepower. This voltage ratio is determined by an electric motor-driven control unit that varies the potentiometer output resistance proportionately to engine torque. The resultant voltage measured on the indicator is proportional to both the potentiometer input voltage variation as well as to the variation of the resistance ratio and, hence, it is proportional to their product or brake horsepower. The wires shown by dotted lines in Fig. 4 may be omitted in the installation provided the equipment is appropriately grounded as shown. It is seen that only one additional wire from the engine to the instrument panel is necessary for the installation of a brake horsepower meter indicator. The electrical power leads for the torque motor unit may be obtained from any convenient source of power in the engine nacelle and will, at most, require only a short length of wire.

An analysis of the possible accuracy of the foregoing combination indicates that an overall maximum error of approximately 3 per cent is feasible. No error is incurred in the engine speed conversion to frequency. An error of 0.5 per cent can be maintained in the conversion from frequency to voltage in the saturated core transformer. An error of 1.5 per cent can be allocated to the torque varied potentiometer and the indicator voltmeter limited to an error of 1 per cent. The total error is considered tolerable in view of the fact that the scale calibration of a standard aircraft indicator, having a 270° pointer movement, will not permit the reading of the instrument beyond an accuracy greater than 3 per cent.

The following is a summary of some of the more important advantages of the horsepower meter as described in this paper:

(a) It makes increased accuracy of engine control possible. Horsepower determination within 3 per cent is possible.

(b) It provides a continuous check on engine operation and makes possible the detection of leaky valves and ignition trouble through the reflection of a loss in engine horsepower output.

(c) It provides an immediate confirmation of take-off power under all conditions of operation.

(d) It provides a simple means of instrumentation for torquemeter operation of engines in the light of existing instrumentation limitations.

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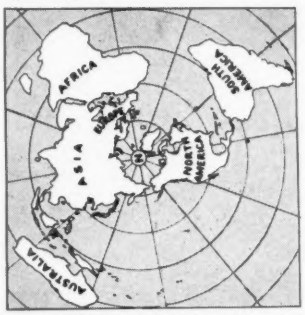
Today, for example, *no spot on earth is more than 60 hours' flying time from your local airport!*

In a world which the plane has made so small, no nation can ever again hope to lead a hermit's life. Be-



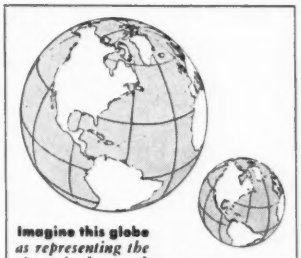
POLAR AZIMUTHAL EQUIDISTANT PROJECTION

Because a global map, *centered at the North Pole, best shows true relationships in today's Air Age world, such maps have now been introduced into almost all U.S. schools.*

cause of the plane, natural barriers have been flattened out, protective oceans have become mere mill ponds, and thousand-mile distances must now be reckoned in terms of a few hours and minutes.

In such a world, to win the war and survive as a nation, America *must* become supreme in the air. To win the peace and make it a lasting peace, air supremacy, again, is a "must."

An awakened, air-minded America is showing that it knows how to *use* air power. The tens of thousands of men and women who make up the U. S. aircraft industry will continue to see that America *gets* it.



Imagine this globe *as representing the size of the earth just a few years ago.* **Today, because of** *the plane, the earth has shrunk to half that size or even smaller.*

CONSOLIDATED VULTEE AIRCRAFT CORPORATION

San Diego, Cal. • Vultee Field, Cal.
Fort Worth, Texas • New Orleans, La.
Nashville, Tenn. • Wayne, Mich. • Allentown, Pa.
• Tucson, Ariz. • Elizabeth City, N. C.
• Louisville, Ky. • Miami, Fla.
Member, Aircraft War Production Council

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QUICK FACTS FOR AIR-MINDED READERS

All the bombs dropped on London during the 4 years of World War I could be carried over Germany in a single trip by one squadron of today's big Consolidated Vultee Liberator bombers.

• • •

Consolidated Vultee builds the 4-engine, long-range Liberator bomber, the huge Coronado, (33-ton, 4-engine Navy patrol bomber), the Catalina, (famous twin-motored Navy patrol bomber), and the Liberator Express, (4-engine transport version of the Liberator bomber).

• • •

In addition to big bombers and transport planes, Consolidated Vultee also builds the VALIANT, (basic military training plane), the VENGEANCE, (dive bomber), the SENTINEL, (liaison observation plane known as the "Flying Jeep"), and the RELIANT, (navigational trainer)

• • •

How to tell the big ones: The Liberator 4-engine, long-range bomber has twin rudders like this

The Flying Fortress, which is also a 4-engine, long-range bomber, has a single rudder like this

• • •

More people are employed today at the San Diego Consolidated Vultee plant than were employed in all San Diego before the war.

• • •

The U. S. Navy has just placed a $30,000,000 order for additional Catalina amphibian long-range patrol bombers which, when completed, will release for combat and convoy duty many U. S. Navy destroyers and other surface craft now engaged in patrol work.

• • •

In the average six-room house, there are 2000 feet of electrical wiring. In every Liberator bomber, there are more than 5 miles of electrical wiring.

• • •

How big will tomorrow's planes be? Consolidated Vultee has designed and built full-size wooden models of a 400-passenger plane and a comparable-sized bomber. Production plans are being speeded.

LIBERATOR 4-engine bomber — CORONADO, CATALINA, and CORREGIDOR patrol bombers — LIBERATOR EXPRESS 4-engine transport — VALIANT basic trainer — VENGEANCE dive bomber — SENTINEL "Flying Jeep" — RELIANT navigational trainer

IT'S THE NUT THAT LICKS FASTENING PROBLEMS

THINK of the tough jobs for nuts on planes, tanks, guns, naval vessels and production equipment.

And it's in these jobs you'll find Elastic Stop Nuts.

In fact, you'll find more of them than all other lock nuts combined.

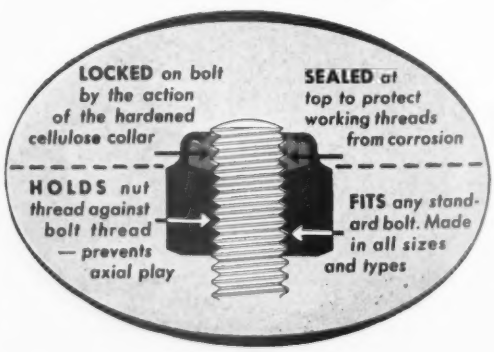
The reason is, these nuts stay put.

Once on, they're set – don't shake loose even under severe vibration. And you can take them off and put them on many times and they won't lose their locking ability.

When peace returns, they're going to solve all kinds of manufacturing problems. They're going to relieve maintenance engineers of frequent inspections and *save time and money in replacements.*

Our engineers have been solving fastening problems for years – the stickers of both peace and war.

Whenever you have a fastening detail to be met, feel free to call upon us. We'll gladly share our experience and recommend the right Elastic Stop Nut.


LOCKED on bolt by the action of the hardened cellulose collar
SEALED at top to protect working threads from corrosion
HOLDS nut thread against bolt thread — prevents axial play
FITS any standard bolt. Made in all sizes and types

ELASTIC STOP NUTS

Lock fast to make things last

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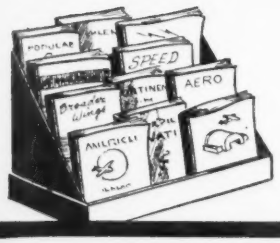

Periodicals

Aerodynamics

A New Method of Longitudinal Control for Aircraft by Use of an Adjustable Angle of Attack Balance. Roland J. White. A new method of aircraft longitudinal control is given which is believed will permit the center of gravity range of the airplane to be substantially increased, as well as reduce the control forces in a more satisfactory manner than is customary. This method essentially provides a cockpit control by which the pilot may regulate the elevator hinge moment characteristics according to an estimate of the airplane center of gravity and enables the pilot to make the airplane stable during a climb or in level cruising flight or maneuverable when he so desires. The cockpit control is a means for regulating the amount the elevator hinge moment changes for a given change in angle of attack of the airplane horizontal tail, as expressed by the elevator hinge moment coefficient derivative.

To obtain this regulation a method is proposed whereby the foreward part of the stabilizer is made movable and is connected to the elevator by an adjustable linkage system so that it may move in a regulated manner with the elevator. A second method consists of allowing a small surface within the stabilizer to move in an adjustable relation to a tab attached to the elevator, the internal surface being vented to the airfoil surface.

In the first part of the paper the elevator control forces are analytically calculated in order to show how the various physical characteristics of the airplane affect the longitudinal control forces. Following this, an example airplane having arbitrary dimensions is selected, and control forces are calculated in order to demonstrate the use of the developed equations and to indicate the improvements that may be realized.

In the second part of the paper wind-tunnel results of the two methods are given, along with charts and equations permitting the engineer to design properly such a control system. *Journal of the Aeronautical Sciences*, May, 1943, pages 152–160, 10 illus.

Torsional and Aileron Flutter. Zbigniew Krzywoblocki. The aim of this paper is to find an approximate solution of the influence of various elements on the critical frequency in a binary system of torsional and aileron vibration. Assuming the system as a nonconservative one and taking into account the results obtained by von Kármán and Biot, the influence of the kind of material and wing shape and airfoil thickness on the torsional frequency is considered. It is to be noted that damping is not taken into account. The idea of "wing torsional rigidity" is introduced, being inversely proportional to the angle of twist at the end of the wing. The problem of influence of the kind of material, aspect ratio and span, wing taper and airfoil thickness on the torsional frequency is solved in a first approximation from the point of view of proportion. Finally, the influence of various materials of wing and aileron is taken into consideration. An attempt is made to solve this problem by the aid of the partial differential equation based on Newton's Law. The equation is applied to an oscillating rod and permits the first natural frequency of the oscillating rod to be found. Using the Membrane Analogy, the differential equation is applied to a tubular member. The results are checked by the aid of Rayleigh's Method. The following conclusions are drawn:

(a) With regard to the influence of the kind of material on the binary system of torsional and aileron vibration, the decisive factor is the ratio of modulus of rigidity to the specific weight. High values of this ratio are obtained for steel and magnesium alloys; wood has the lowest ratio.

(b) The influence of span and airfoil thickness are significant and the influence of wing taper is less important.

(c) When a tubular member consists of various materials, a decisive factor is also the ratio of the modulus of rigidity to the specific weight. The following combinations might be advantageous: aluminum alloy or magnesium alloy wing and steel aileron, spruce-plywood wing and metal aileron.

(d) Three different methods lead to the same result—that, from a system of torsional oscillation standpoint, the decisive factor is the ratio of the modulus of rigidity to the specific weight. The methods include the computations based on the magnitude

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THE SAME METHODS WILL WIN YOUR POST-WAR BATTLES

Since welding is taking such a big hand in winning the war, why shouldn't I watch it closely for ideas to win my battles for business after the war?

ALTER EGO: That's logical. Where you see welding, you see faster production and far better ships, planes, tanks and guns. The same basic methods can be used after the war to cut costs and build better autos, machines, appliances and buildings.

Can I get any ideas from the wartime gasoline tanks they're welding here?

ALTER EGO: Sure! In the first place, they're welded. And they're welded fast. Ever hear of welding 10 to 14-gauge sheet with 3/16" electrode? Usual practice requires 1/8" or 5/32" size. This shop developed fit-up jigs and positioning fixtures to allow the 3/16" size. *This bigger electrode saves them 33% in man-hours.*

Then, the big problem is not only to find ways to apply welding to my post-war products, but to find ways to beat competition on the cost of my welding.

ALTER EGO: You're right. You should use this double approach to post-war profits by keeping an eye on the big war-job welding is doing . . and by all means, ask for Lincoln cooperation on design and production.

THE LINCOLN ELECTRIC COMPANY
CLEVELAND, OHIO

then I said to myself—

THERE'S ALWAYS SOMETHING NEW UNDER THE ARC

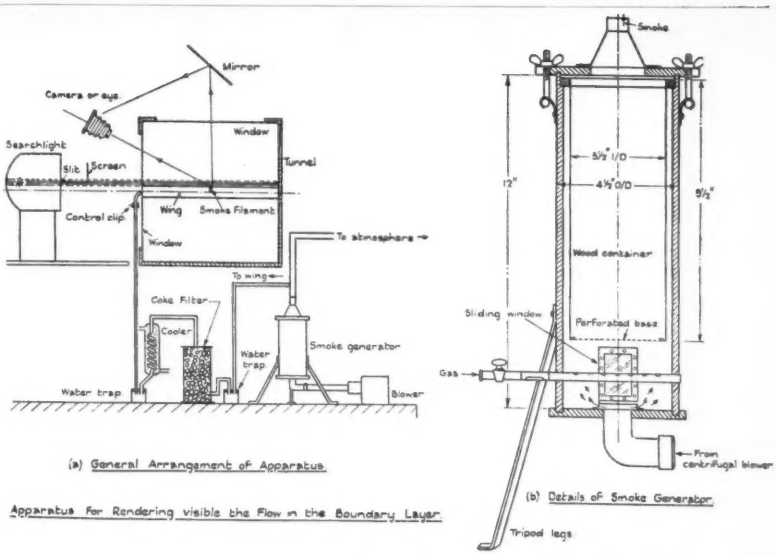
of the torsional frequency given by von Kármán and Biot, the differential equation based on Newton's Law, and Rayleigh's Method.

(e) The results obtained cannot be applied directly to practice because of the fact that damping, an important factor from wing flutter point of view, was not taken into account. *Journal of the Aeronautical Sciences*, May, 1943, pages 161–168.

Wood Smoke as a Means of Visualising Boundary Layer Flow at High Reynolds Numbers. J. H. Preston and N. E. Sweeting. A technique for visualizing the flow of air in the boundary layer of wings by means of smoke is described. The experimental work was carried out in the Aerodynamics Department of the National Physical Laboratory. It is explained that the success of the method is due to the use of wood smoke in place of the chemical smokes previously employed. The new technique is found to provide a rapid means of locating laminar separation, transient points or regions, and turbulent separation, enabling an idea to be formed of the thickness of the turbulent boundary layer. A description of the smoke-producing apparatus and the experimental technique is given. *The Journal of The Royal Aeronautical Society*, March, 1943, pages 93–102, 5 illus.

Airflow Visualization Opens New Avenues of Research. Erwin J. Saxl. Projector equipment and a photographic method of approach are described which have made it possible to make visible in the laboratory the phenomena encountered under conditions of high air velocity. A further purpose is the visualization of gases passing at high velocity past objects or of objects passing at high speed through gases. It is stated that, in addition to the improvements that have been made in the optics which permit airflow observations and in the methods of recording, the magnitude of the relative velocities at which the phenomena are observed may be calculated. The method is stated to be applicable to the study of air-stream action in internal combustion engines and in problems of compressibility, as well as in the design of aerodynamic structures.

Suggestions are made for the further application of the new technique, and working hypotheses are offered for the explanation of the optical and aerodynamic phenomena observed. The writer proceeds with a historical review of the work previously done in optical investigation and then describes in detail the arrangement of apparatus and the steps taken in the investigation. *Aviation*, April, 1943, pages 148–151, 326, 329, 12 illus.



Apparatus for Rendering visible the Flow in the Boundary Layer

Courtesy of The Journal of The Royal Aeronautical Society

Wood smoke apparatus for visualizing boundary layer flow.

Air Cargo

Package for Cairo. Frederick Sondern, Jr. A description of how the Air Transport Command is transporting freight from a Florida airport to various war theaters including Africa. The technique involved in handling air freight is outlined. The writer explains the way freight from many sources is received at the warehouse, unpacked from heavy cases, and repacked in light plywood sheathes that are bound with special wire. Airplane engines are mounted on metal dollies that can be rolled into position and bolted to the floor of the cargo plane. The warehouse chief receives a schedule of the planes that are leaving and allocates the freight to them. Phases of military air transport are discussed. *Air Facts*, May, 1943, pages 7–14, 2 illus.

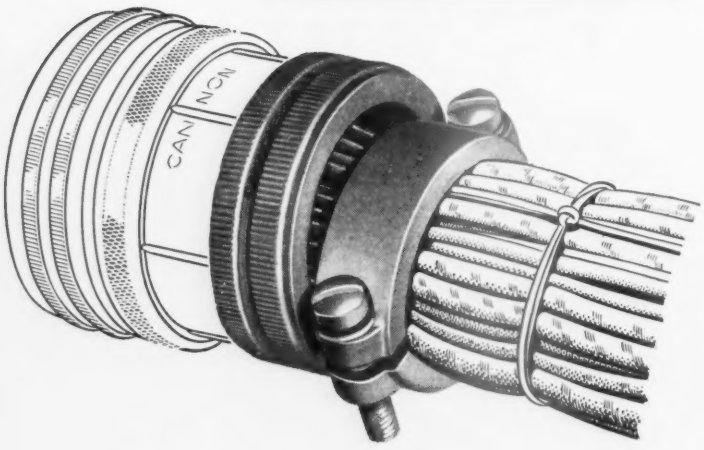
Is Air Transport Forgetting the Small Town in Planning for Future? Harry R. Stringer. Unexplored opportunities that may lie in the field of air transport of the future are discussed. That there will be a great expansion of air transport after the war is stated to be a certainty. The writer refers to the large tonnage of troops and supplies which is being carried by military transport planes as an indication of the efficiency and versatility of the airplane. It is stated that the postwar surplus of aircraft production facilities, pilots, technicians, and planes will give added impetus to air transport expansion, although no peacetime system immediately conceivable will be able to absorb aircraft at the present rate of production. The influence of the glider and helicopter on future air transport developments is considered and the possibilities of air parcel post are discussed. *Air Transportation*, April, 1943, pages 28–34, 3 illus.

Air Power

Bombing Eastern Europe Key to Nazi Defeat. John A. Ward. On the assumption that an invasion of the European Continent is not possible in the near future, the writer proposes that a concentration of intensive bombing raids be conducted by American and British air power against the industrial centers of eastern Germany through the shifting of American and English heavy bombers and fighters from England to Russia. Pointing out that a great part of Germany's industrial power is concentrated in Eastern Germany and in Czechoslovakian, Hungarian, Polish, Rumanian, and Baltic war production centers (including Kiev and Odessa), he claims that effective blows against these areas would produce more immediate results toward winning the war than present American and British bombing operations against western German centers. It is suggested that supplies and personnel that could not be transported by air could be convoyed from the British Isles around the North Cape to Murmansk. One of the other transfer methods recommended is the flying of planes from Africa to Russia.

The writer's plan designates Leningrad, Moscow, and Rostov as the pivots for combined American, British, and Russian heavy bombing operations against eastern German industrial centers. Squadrons operating out of Leningrad would have the eastern Baltic, Estonia, Latvia, Lithuania,

THE CANNON "AN" CABLE CLAMPS



...give security in operation and diversity in application!

Type "AN" cable clamps are designed to fit all eighteen shell sizes in Types AN3100, AN3106 and AN3108 Cannon shells. This includes the wall-mounting unit, the straight connector and the angle 90° connector of an AN series.

Fabricated of aluminum alloy, these Cannon AN cable clamps eliminate the need of flexible metal conduit, thus conserving essential war metals. They fit snugly on a certain number of wires but have to be built up if wire cable diameters are smaller than the clamp minimum. Cable entrances range in size from 17/64" to the maximum of 2-13/32".

Cannon cable clamps, like Cannon Connectors, are designed and developed to meet the most exacting requirements of engineers. They are precision-made with one thought in mind . . . to manufacture the finest product of its kind, dependable under any and all sorts of operating conditions.

New Second Edition Ready!
AN Cable Clamps are completely described in the new Cannon AN catalog. If you have not yet received your copy, address Department B, Cannon Electric Development Company, Los Angeles, California.

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and Finland as their zone of activity; Warsaw, Brest-Litovsk, Lodz, Vilna, Minsk, etc., would be brought within the range of Allied air power from the Moscow bases; and the Ukraine territory would be vulnerable to the Allied aircraft stationed in the vicinity of Rostov. *Aero Digest*, April, 1943, pages 109–111, 142, 277, 13 illus.

Wanted: True Air Strategy. Major Alexander P. de Seversky. Recent aeronautical developments in the light of air-power facts are discussed. The writer declares that, while the United States has more and better aircraft, they do not represent air power in the sense that General "Billy" Mitchell and his followers used the term. A separate governmental air department is advocated and a revision of America's military organization to give air power equality with other services is advised. *The American Mercury*, May, 1943, pages 562–571.

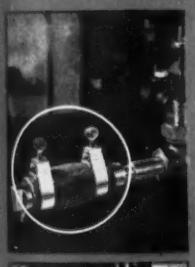
China in the Air. V. L. G. This article not only describes the ingenuity with which China has derived the greatest possible use from a small air force but also pleads the urgency of supplying her with up-to-date Allied aircraft types for a more offensive air strategy. It reviews the genesis of the Chinese Air Force: its organization; the support it received from Russia before the Russo-German combat; the development of special defensive techniques; the effect of lack of air support upon ground operations, personnel resources, landing facilities, air tactics, and intelligence work. It also reviews the countermethods followed by the Japanese and presents an analysis of why it is desirable from the Allied point of view to reinforce China's air strength so that Japanese first-line aircraft may be diverted from other sectors. *Flight*, March 4, 1943, pages 230–233, 6 illus.

London Survey. Peter G. Masefield. The technical editor of *The Aeroplane* evaluates the offensive aerial power of the United Nations and discusses its strategic application against the Reich. He comments on armament and performance features of various American, British, and German airplanes. Tabulated data, showing relative weight per minute, offers a comparison of the fire power of Allied and Axis planes. The armament, total weight of fire for all guns, and weight of fire possible against one target are listed for the Boeing B-17, Bristol Beaufighter, de Havilland Mosquito, Messerschmitt Me 210, Hawker Hurricane IIc, Focke-Wulf Fw 190A3, Grumman Wildcat, Supermarine Spitfire IX, Bell Airacobra, Avro Lancaster I, and the Messerschmitt Me 109F1. The figures indicate that the American and British bombers and

Outstanding in Performance!

Yet—made of noncritical steel

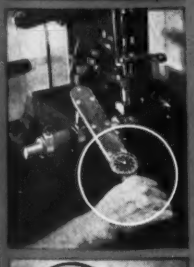
Consolidated B-24 Liberator equipped with Wittek Aviation Hose Clamps



Exceeds

LEAK TEST REQUIREMENTS

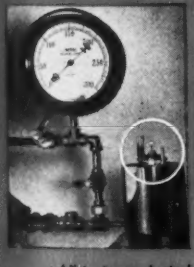
Two Wittek Type FBCA Hose Clamps installed on 1-inch I.D. hose to a wrench torque of 20-inch lbs. Pressure applied inside the hose is 210 lbs. per square inch *without leakage.*



Exceeds

WRENCH TORQUE REQUIREMENTS

Wittek Type FBCA Hose Clamp installed on hose to a wrench torque of 118 lbs. *without failure* to any parts.



Exceeds

STRENGTH REQUIREMENTS

Wittek Type FBCA Hose Clamp being load tested without hose. Load imposed on the Clamp is 2970 lbs. *without failure.*

All tests conducted as outlined in Army Specifications 25529, April 14, 1942

Wittek Types FBC and FBCA Aviation Hose Clamps

Made of noncritical mild carbon steel, and zinc plated for corrosion resistance, Wittek Types FBC and FBCA Aviation Hose Clamps have performance characteristics comparable to hose clamps that were made of stainless steel.

Wittek Aviation Hose Clamps, known as the standard of the industry since the beginning of modern aviation, are now being used by the nation's leading military aircraft and engine builders. Wittek FBCA Hose Clamps meet all requirements of Army Air Forces Specification 25529. Wittek Manufacturing Co., 4305-15 West 24th Place, Chicago

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ARMY E NAVY

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...your way of life! Every man interprets it a little differently, but to us all it means a car, a radio, a refrigerator; the right to those things that make our daily life pleasanter, more convenient, more exciting. Today Weatherhead plants are producing vital parts for planes, tanks, ships, trucks and munitions at the rate of *millions every twenty four hours.* The coming of Peace will find us prepared to join with you in building the durable goods all the world will want from America as well as many strange new devices that are even now being born in the war.

Look Ahead with

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fighters are superior to those of the Germans in all categories, but they also reveal certain weaknesses which, it is stated, can be overcome. *Flying*, May, 1943, pages 44, 45, 161, 162, 2 illus.

The Promise of Air Power. Part II. Tom Ashley. The second part of an article that reviews the basic principles of United States air power gives the development of different types of bombardment and their contributions to air superiority. American emphasis upon heavy bombardment is pointed out, the origin of medium bombardment is traced as an outgrowth of attack aviation, and an inadequacy is noted in the development of battlefield aviation. Certain German and British theories of air power are also mentioned.

The writer's conclusions are that, while the United Nations are extremely powerful in long-range, heavy bombardment aviation, they are still inferior when it comes to battlefield aviation. However, he states, their A-20's and medium bombardment planes are superior to the Stuka. *Southern Flight*, April, 1943, pages 22–24, 7 illus.

Air Transport

The Future of Air Commerce. Major R. H. Thornton. In this abstract of a paper read before the Institute of Export, the writer considers some of the problems of British Air Commerce after the war. By comparative figures on aircraft and ship pound-miles per horsepower transport, he demonstrates the fallacies of those predictions that promise cheap high-speed air transport. He also indicates the reductions in costs that can be looked for and explains why passenger transport is a particularly likely field of exploration for air commerce.

The article stresses the need for internationalizing air transport over Europe and discarding hampering multinational rules and takes up the questions of subsidies, monopolies, and standards of efficiency engendered by competition. British and American policies with regard to competitive practices are compared. *Flight*, March 4, 1943, pages 226–228; "The Future of British Air Commerce," *The Aeroplane*, March 5, 1943, pages 272, 273, 3 illus.

Fly Them into Action. Major Sedley Peck. The problem of transporting military aircraft to the fighting fronts is discussed. A project for floating air bases to facilitate the flying of planes across oceans, recently presented to the Government for consideration by Capt. Bernard Brookes, is outlined. Advantages of the plan, which was offered as a solution to the transport problem, are summarized. *U.S. Air Services*, April, 1943, pages 33, 34.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Survey Pilot. Charles Kennett. An ex-R.A.F. squadron leader describes the work of laying out an intercontinental air line and his experiences in carrying out the undertaking. It is shown that the job required not only skillful airmanship but diplomacy as well. The route surveyed was from LeBourget, France, to Northwest Africa. *Air-Age*, June, 1943, pages 22, 23, 66, 67, 3 illus.

Car to the Airport. Lynn H. Kerrington. Some statistics on the cost of automobile transportation from city to airport show that the charges on a cost-per-mile basis are from one and one-half to 13½ times as much as those of air travel. Covering transportation by limousine and taxi, different rates charged in representative American cities are discussed. However, the article also notes some of the costs attendant upon the operation of such services and reports statements by operators in vindication of the charges. *Flying*, May, 1943, pages 76, 82, 1 illus.

Passenger 'Servicing' Keynotes Future. E. J. Foley. The writer recommends an examination into the adequacy for tomorrow's trade of today's air-line passenger-servicing policies. The influence of the war on these policies is discussed. It is stated that under today's operating conditions it is apparent that the air lines are alert to service requirements and are maintaining the maximum practical level but that all premises may not hold in an era of 100,000-lb. 300-m.p.h. aircraft, international networks of routes, and airports still further removed from metropolitan areas. Those items that are air-line controlled—ticket service, food service, and scheduling—are discussed. *American Aviation*, April 15, 1943, page 58, 1 illus.

Short-Haul Air Transportation America's Little Air Giant. Air-line development in America is discussed with particular attention to the subject of short hauls. It is shown that in the beginning short hauls were neglected because air-line pioneers thought in terms of distant horizons when laying out routes. It is recalled that because Cleveland was chosen as a stop on the first transcontinental air line, Pittsburgh was left without air-line service. The article describes how a Pittsburgh automobile man founded a shuttle run, consisting of three Waco planes and a staff of 20 persons, to serve as a connecting link with the transcontinental mail. This service soon gave way to Pitcairn mail service and Pittsburgh was definitely placed on the air map. *National Aeronautics*, April, 1943, pages 14, 15, 36-9 illus.

Airplane Descriptions

Britain's Secret "Sky Rocket." Joan Bradbrooke. General information is given on the construction and performance of the Hawker Typhoon. Although certain details of this high-speed destroyer fighter are still secret, the writer states that its top speed exceeds 400 m.p.h., that it has a longer range than either the Hawker Hurricane or the Supermarine Spitfire, and that it is heavily armored and easily maneuverable. The Typhoon, a single-seater plane, is powered by a 24-cylinder H-type, liquid-cooled Napier Sabre engine. *Skyways*, May, 1943, pages 93, 94, 96.

Luftwaffe Allsorts. From notes released by the British Air Ministry, additional details on certain German aircraft and engine types are given. Included among these is the Messerschmitt Me 323 which, although it is a transport monoplane with six engines of 700–800 hp. each, is termed a "powered glider." The unorthodox design of the multiwheel undercarriage is one of the features of this transport. Three-view general arrangement drawings accompany data on the Blohm and Voss BV 222 six-engined flying boat. High-altitude Junkers airplanes and the Daimler-Benz DB 606 double engines, described as two DB 601 units mounted side by side and driving a single airscrew through an extension shaft, are also discussed. *Flight*, March 11, 1943, page 260, 2 illus.

Flying the Curtiss "Commando." Herbert O. Fisher. Some of the operational features of the Curtiss C-46 Commando are described by instructing the reader how to perform the take-off, climb, landing, etc. Stability and speed are marked as the two most important features of the C-46. *The Sportsman Pilot*, April, 1943, pages 14, 15, 4 illus.

Messerschmitt 210. Paul Andrews. Additional information is given on the structural details, armament, and armor of one of the latest German airplanes, used as a long-range fighter

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and bomber escort, a dive bomber, and a low-level attack plane. Structural details are compared with those of other aircraft of that make. The power plants are stated to be similar to that of the Messerschmitt Me 109F, differing in the method of mounting, which is called unique, and in having cooling ducts. The engine mount is reported to reverse the usual German practice, the main supporting members being welded steel box girders in compression, with standard shock-absorber mount held in position by oversize circlips at the two pickup points on the engine. These extend to a ball joint at the firewall and are joined by a diagonal tubular support. The small number of structural members is credited with aiding the high-speed production of the plane. The additional armament is called the principal point of interest, and details on the armament and its controls, as well as the design of the diving brakes and other components, are given. Sketches clarify the descriptions. *Air News*, April, 1943, pages 7–9, 56, 7 illus.; "Messerschmitt Me-210-A-1," *Aviation*, April, 1943, pages 235, 237, 2 illus.

P.E.2s and Stormoviks. Two Russian aircraft, the Stormovik and the P.E.2 medium bomber, are briefly described. The information on the Stormovik refers mainly to its armament and the jet propulsion system of discharging rocket bombs from beneath its wings.

The twin-engined P.E.2 is stated to be similar in some respects to the Me 110, but it is noted that a rearward firing turret is fitted beneath its fuselage. Applicable for either precision or dive bombing, this plane is reported to have a top speed exceeding 300 m.p.h. and an internal stowage capacity for about 1,700 lbs. of bombs. *Flight*, March 18, 1943, pages 276, 277, 6 illus.

Airplane Spotting

Cosas del Japon (Japanese Items). Identification marks of Japanese airplanes are explained. The numbers correspond to the last two digits of the year of the Japanese calendar when the airplane was built, 94 to 00 meaning aircraft built in the Japanese years 2594 to 2600, respectively. For further classification the letters are abbreviations of Japanese words that denote the purpose of the various aircraft, as follows: B. for Byoinki or ambulance plane; R.K. for Rikugun Kyoryoku or army liaison plane; K. for Kyukoki or dive bomber; S. for Sentoki or fighter or pursuit plane; S.H. for Suijo Hikoki or seaplane; H. for Hikosen or flying boat; O.B. for Omoshi Bakudanki or heavy bomber; K.B. for Karui Bakudanki or light bomber; T. for Teisatsuki or scouting plane; K.T. for Kaijo Teisatsuki or scouting seaplane; G. for Gyoraiki or torpedo plane; K. for Kyorenki or training plane; and Y. for Yusoki or transport plane.

Navy airplanes include the following types: fighter planes—Mitsubishi S-97, S-00, S-00-2, S-01 and Nakajima S-01; torpedo planes—Mitsubishi G-97-1 and Nakajima G-97-2; scouting seaplanes—Aichi KT-98, KT-97, Kawainishi KT-94, and Nakajima KT-95; medium bombers—Mitsubishi B-96-1 and Oteri, B-00, B-01; heavy bombers—Mitsubishi OB-96-4, OB-00; dive bombers—Aichi K-99, Nakajima K-01; flying boat—Consolidated H-98.

Army airplanes are as follows: fighter planes—Kawasaki S-98 and Nakajima S-97; heavy bombers—Mitsubishi OB-98, OB-97 and Kawasaki OB-97; light bombers—Mitsubishi KB-98 and Kawasaki KB-97; transport planes—Mitsubishi Y-98 (MC-20) and Nakajima AT; Junkers Y-95 (Ju-52/3m). *Aeronautica*, January-February, 1943, page 24.

The Brewster F3A Navy fighter. This is a counterpart of the F4U Corsair designed for carrier operations. (*See* page 151.)

Armament

The MG 131. The construction, performance, and operation of the MG 131 aircraft gun are described. Indicated as the standard defensive weapon for the Luftwaffe's bombers and fighter bombers, the MG 131's flexibility of application is demonstrated as one of its advantages. It is specified as a 13-mm. (0.512-in.) machine gun with a barrel length of 550 mm. (21.65 in.) and an overall length with flash-damping tube of 1.170 mm. (46.06 in.). Possessing a firing rate of 900 rounds per min. and a muzzle velocity of 750 meters per sec. (2,500 ft. per sec.), the MG 131 can be installed either in lenticular mounts or on gun rings, singly or in pairs, or rigidly mounted and remotely controlled.

The article also contains some preliminary data on the German guns, including the MG 17, standard machine gun for German fighter airplanes. The loading systems and ammunition are also described. *Flight*, March 18, 1943, pages 285, 286, 5 illus.

Quelques notes sur l'évolution de l'armement áerien (Some Notes on the Development of Aerial Armament). E. J. Sudan. A review of the armament carried by modern fighter and bombing planes as compared with those of World War I. It is shown that now, as then, the machine gun is the most essential weapon, while the use of cannons gradually has become more widespread. The writer states that the French planned to use cannons aboard military aircraft as far back as 1916. After many unsuccessful experiments the Hispano-Suiza organization developed a cannon engine, the 220-hp. Hispano. The increase of fire power and range of fire of modern military aircraft resulted in corresponding improvement in their armor, and the use of turrets transformed the combat airplane into an actual fortress. *Schweizer Aero-Revue*, October, 1942, pages 409–411, 4 illus.

The Pursuit Effect. Lt.-Pilot B. A. Rabineau. A discussion of the relative hitting power of gunfire directed forward at a retreating bomber by a pursuing fighter and fire directed backward from the bomber at the fighter. The ballistics of forward and rearward firing are compared, as well as the probabilities of hitting and the penetrative power of bullets, and relative wind values are studied. It is noted that the maximum protection from the enemy's forward fire is given by an advantage in speed, whereas maximum efficiency of rearward fire is obtained by the enemy's speed advantage. The selection and use of rear armament are discussed and the advantages are summarized. *Aeronautics*, April, 1943, pages 50–57, 6 illus.

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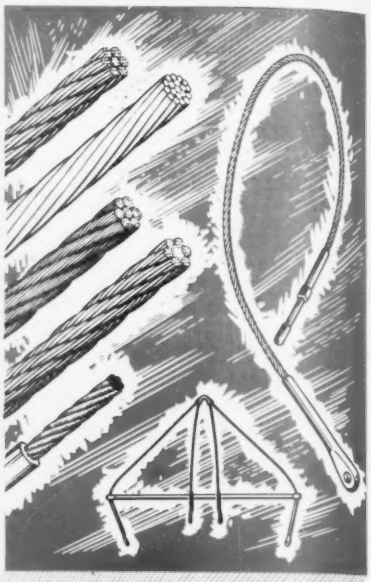

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Avigation

McMillen's Spherographical System of Celestial Navigation. Dirk Brouwer and F. W. Keator. This article is taken from a manual, which is as yet unpublished, containing a description of the apparatus and an exposition of its principal uses. The general plan of the McMillen method is outlined. The instruments used, consisting of the spherical compass, a great-circle ruler, and a spherical protractor, are described. Methods are then given and illustrated, by examples, for plotting geographic points, a two-body fix, a great circle track between two points, and selecting suitable stars for a fix. Flights in polar regions present problems of some difficulty because of the effect of the rapid changes in magnetic variation upon the magnetic compass. Allowances for such conditions are discussed and instructions are given for daytime navigation.

The construction of a running fix is described, as well as an alternative method that is exemplified by three cases, with precautions regarding azimuths. It is shown that no accurate timing of tangency is necessary but that the construction of a fix can be made only on a sphere and not on a flat-chart reproduction of the sphere.

The merits of the system are summarized, showing that the operations can be carried out in five rapid and accurate steps, with simplicity as one of its great advantages. The disadvantages that some critics have mentioned are also given. *Aero Digest*, April, 1943, pages 116–118, 139, 140, 266–268, 4 illus.

Dead Reckoning Navigation. E. L. Collins. A study of computations based on the triangle of velocities. Fundamentals of dead-reckoning navigation are simply and concisely explained. With a description of the use of each column, a suggested log for recording the necessary navigation information is illustrated. *Flying*, May, 1943, pages 65, 66, 132, 4 illus.

Spherographical Navigation. The McMillen Spherographical System of Avigation is discussed. Although the article acclaims the system as an advancement in instructional systems and as a visual method of teaching, it criticizes its failures in practical application. Costliness, many opportunities for inaccuracy, and the fact that it does not materially reduce the number of necessary operations in computing time and the other fundamentals are listed among its defects. What are stated to be basic flaws in the McMillen System are outlined under the following headings: Scale, Instruments, Simplicity, and Plotting Dead Reckoning. Accompanying photographs visually describe the McMillen process. *Skyways*, May, 1943, pages 20, 21, 86, 90, 97, 6 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Business and Finance

Shifting Prospects for Airline Revenue and Profits. Raymond L. Hoadley. The trend of earnings for air-line securities for 1943–1944 are forecasted. The writer's conclusions are that, although operations for nearly all air lines seem likely to continue on a profitable basis for the duration, the earnings reached their wartime peak in 1942. Analyzing the factors affecting this situation, he discusses the probability of a decline in the heavy volume of passenger and express traffic, the possibility of fare reductions, mail pay cuts, excess profits tax, and war contracts. The point covered most thoroughly in the article is that of the excess profits tax. *Aviation*, April, 1943, pages 205, 207, 407, 1 illus.

Civil Aviation

When Is a Man Too Old to Fly? Charles I. Stanton. The Administrator of the Civil Aeronautics Administration discusses the relation between age and flying ability. He explains that a man may be too old to fight but still not too old to pilot a plane and take his part in war aviation. Examples are given of aviation men who are above the maximum age at which the Army can use them but who are doing their part in the war. Many of these are instructors at civilian contract schools. Others are performing important duties in the C.A.P. It is shown that many top places in the C.A.A. are held by men who first began to fly decades ago. *National Aeronautics*, April, 1943, pages 17, 46, 3 illus.

What if the Engine Quits? Lt. Comdr. B. P. Churchill. To prevent the danger of accident due to engine failure, the writer suggests the further development of a reasonably priced two-engined plane for civilian use which would show good performance on one engine and could actually complete a take-off even if one engine failed. He recommends the use of two 80-hp. fuel-injection engines, connected through a so-called free-wheeling mechanism to an automatic constant-speed propeller. The advantages are summarized as increased usefulness, safety, and pleasure, combined with low cost. *Air Facts*, May, 1943, pages 32, 33, 36, 2 illus.

Companies

Consolidated Celebrates its 20th Anniversary. Supplemented by a record of the types of airplanes the company has produced, the history of Consolidated Aircraft Corporation during the past 20 years is traced. Starting with an initial order for 20 training planes in 1923, Consolidated has developed and manufactured primary trainers, two-seater biplanes, flying boats, land-based bombers, and transports. Consolidated's 20th anniversary is marked by a merger with Vultee Aircraft, Inc. Called the Consolidated Vultee Aircraft Corporation, the company now produces in its Consolidated group of planes: the Catalina, the PB2Y Coronado, the B-24 Liberator, and the C-87 Liberator Express. Its Vultee group of planes include the BT-13, the Sentinel, the Reliant, and the A-31 Vengance. *Aviation*, April, 1943, pages 122–125, 404, 15 illus.

Design

Photoprint Process of Loft Layout Reproduction. Frank B. Marshall. The Photoprint process for the reproduction of mold loft layouts, drawings, and master boards is described as incorporating the Taber-Van Dusen method of contact printing. A subject to be reproduced is placed in direct contact under pressure with the sensitized surface of the material upon which it is to be reproduced. It is stated that the result is undistorted and includes all lines and markings as they appeared on the original. Any desired quantity of duplicates, including left- and right-hand prints from the same original, can be made upon rigid sheets or blocks of metal, plywood, hardwood, plastic, or other materials. The process is used for making full-scale line reproductions of any original layout, drawing, or template on sheets of rigid material or upon paper or linen for blueprinting. It is shown that, since it is a direct-contact reproduction, positive accuracy is achieved and broadening of lines is eliminated. Dimensional sta-

bility of the original is preserved, error is avoided, and the expense of hand copying is eliminated. The process differs from conventional photography in that no camera or lens is used, but it follows photographic processes by using sensitized negative and positive materials that are exposed to light and subsequently treated in chemical baths.

Details are given on the building of the equipment required and a layout is suggested for a photoprinting room. A detailed description follows of the steps involved in the process, carrying it through transference of a drawing to a metal surface and the actual cutting out of the parts as a production operation. *Aviation*, April, 1943, pages 154–156, 159–161, 20 illus.

Lofting Problems of Streamline Bodies. Part 12. Carter M. Hartley and Roy A. Liming. This installment continues the discussion of conic lofting techniques and defines the differences between the graphic approach and the mathematical approach, also indicating that the one technique implements the other. By combining the two, faithfully adhering to calculated data verified by additional mathematical applications, the final layout can be made to represent the desired degree of dimensional integrity. The application of these methods is explained with the aid of sketches. The profile and plane views of a typical fuselage are analyzed, revealing a total of 16 curve sections, two for each of the five basic contours shown in the profile view and two each for the three basic contours shown in the plane view. These sections may all be calculated simultaneously by the use of the special calculation charts described and illustrated in a preceding installment. It is shown that the relative speed of the two methods is an important factor and, to the extent that accuracy can be maintained within allowed tolerance, the speedier of the two methods may be selected. A situation of this sort is taken as an illustration. The article concludes with a summary in which it is stated that the successful application of these techniques has been analyzed and illustrated in sufficient detail to suggest a working basis for the use of the system. *Aero Digest*, May, 1943, pages 200–202, 205, 420, 10 illus.

Weight or Speed? A brief discussion of the effect of the weight of a complete plane on its performance. How the take-off, maneuverability, and climb are influenced by variations in the weight is described with the aid of diagrams. *Air-Age*, June, 1943, pages 18, 69, 3 illus.

Trends of British Bomber Design. J. I. Waddington. A brief analysis of the principal types of British bombers, the missions for which they are designed, and the trend of their current development. The bombers are divided into two main classes—the high-level precision types (including heavy, medium, and light bombers) and the low-level attack types—with the characteristics and techniques of each kind of bombing described.

In considering the postwar conversion of present British bombers to airliners, the writer states that, while this will probably be a necessary measure, it will be a poor compromise. He explains briefly why the specialized design of a bomber does not lend itself to the most efficient kind of civil aircraft. His comments also touch upon armament, the tricycle undercarriage, and trends toward higher altitudes and larger-sized planes. *Aero Digest*, April, 1943, pages 223, 224, 227, 416, 10 illus.

The Twin Engine Fighter Formula. A. Falorde. A conspectus of views on the twin-engined fighter is presented, design factors and some of the operational factors being studied with the object of obtaining a guide to future fighter-plane development. For purposes of analysis, performance and

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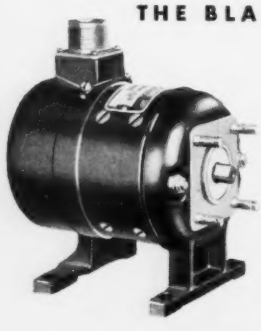

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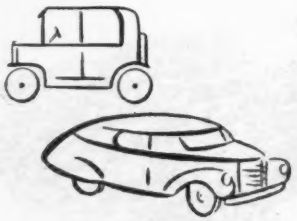
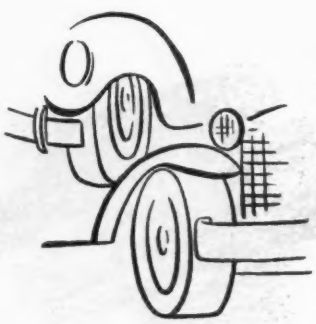


Nylon, in some important ways, is as far ahead of cotton or rayon cord for use in airplane tires as fluid drive is ahead of the old-time foot pedal gear shift. One way in which it is superior to either cotton or rayon is its great strength per unit of thickness. In the design and construction of airplane tires, this characteristic presents great possibilities. Yet, there are still unanswered questions, unsolved problems, unexplored horizons.

In 1939, DuPont announced Nylon to the public—a new miracle material, which among other uses could be made into the sheerest, strongest, loveliest stockings American women had ever seen. "U. S." research men wondered – wondered since Nylon in stockings was stronger, sheerer, more resistant to runs, why it might not be also a stronger, lighter, more efficient material for tire cord than any previously used. With the cooperation of DuPont, they set out to see how this new substance would act as a substitute for cotton or rayon tire cords.



It was natural for "U. S." to undertake this problem because for years "U. S." laboratories had pioneered and developed rayon for tires and "U. S." factories had produced rayon tires for automobiles, trucks and airplanes. With this background of experience in related fields, a practical Nylon construction was soon developed. The earliest laboratory tests indicated possibilities that a superior strength material for use in tire carcasses had been found—that stronger, lighter tires than had ever been known before could be built with Nylon cord.

Then passenger and truck tires were built and tested on dynamometers. Hour after hour, day after day, these tires were run on the giant test wheels without a stop except for a periodic examination. Finally truck tires with Nylon bodies were put into high-speed service over scorching highways. In every test these Nylon-built tires proved that they could outrun and outperform the best tires built of cotton or rayon cord.

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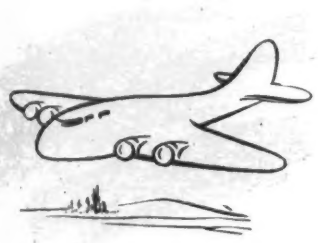

Even before Pearl Harbor, "U. S." tires made with Nylon cord bodies were tested on military aircraft. These Nylon tires outperformed, in carcass strength and in ability to "take it," even the finest of the rayon construction which had been pioneered and perfected by the United States Rubber Company. The results of these military tests under actual service conditions confirmed beyond doubt what already had been found in the laboratory and on the highway.

Many other tests have been conducted in the "U. S." laboratories and in actual service. A six-ply Nylon tire was tested against an eight-ply rayon tire of identical air capacity. The results showed that although the Nylon tire was four pounds lighter and contained 1.7 pounds less rubber, it had a 25% greater strength rating than the rayon tire. Problems have been met and solved. But still the properties of Nylon tire cord are not fully understood. United States Rubber Company research men are testing, experimenting, searching for answers that still lie ahead.

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operational factors are considered separately, although they are actually interrelated. The writer discusses speed as a means of showing the relationship between the twin-engined fighter and the single-engined fighter. A study of the subject made by Clarence L. Johnson, Chief Research Engineer of the Lockheed Aircraft Corporation, is reviewed. The relative drag occurring with the twin-engined and single-engined types is discussed, and operational aspects of the two types are considered. *Aeronautics*, April, 1943, pages 36–42, 8 illus.

Engines

Excess Air and Brake Mean Effective Pressure. P. H. Schweitzer. A formula for expressing the relation between the excess air and the brake mean effective pressure of an internal combustion engine is evolved. The formula is based on the fuel consumption in lbs. per b. hp. per hour, the chemically correct air-fuel ratio, the volumetric efficiency, the scavenging efficiency, and the excess-air factor, which is defined as the actual air-fuel ratio divided by the chemically correct air-fuel ratio. It is explained that the equation has universal validity for either four- or two-stroke-cycle engines, for carburetor engines, and fuel-injection engines of either compression-ignition or spark-ignition type, and for normally asperated or supercharged engines of all types. A simpler formula for four-stroke-cycle engines with negligible contamination of the fresh charge by residual gases is also given. In an appendix the derivation of the fundamental equation is shown. *Transactions of the A.S.M.E.*, April, 1943, pages 159–163, 3 illus.

New Materials for Aircraft Engines. Mel Young and Herman H. Hanink. Because of the great demands of war production it has become necessary to take conservation measures with some elements in particular and with all materials in general. In this article the writers pay particular attention to new developments in the use of steels, plastics, synthetic rubber, and silver. It is noted that aircraft engines will soon have an almost completely new set of alloy steel for the majority of working parts. The NE steels selected for the purpose are discussed and a table of specifications is furnished. Hardenability curves for oil-hardening steels and carbonizing steels are shown. Fatigue curves and hardness-depth curves are also furnished. Discussing plastics, the writer describes the use of these materials for baffles for air-cooled engines, push-rod housings, transparent film for dehydration and preservation of engines during shipment and storage, and plugs containing a drying agent for insertion in engine openings to prevent corrosion. The use of plastics in engine construction is stated to be limited apparently because of temperature and stress conditions encountered in a power plant where the highest output is demanded from the least weight. The development of synthetic rubber for certain engine parts is reviewed. Research has reduced a great many of the processing difficulties, and careful selection of plasticizers, fillers, and curing agents has provided a variety of compounds for specialized applications. *S.A.E. Journal*, May, 1943, pages 157–164 (Transactions), 18 illus.

German Engine Projects. Accompanied by drawings, brief descriptions are given of two new German aircraft engines: one a multibank Junkers radial and the other a twin Daimler-Benz installation operating a single propeller. Although particulars are given on each engine, those on the Daimler-Benz are more detailed. The belief is that the four-row, 24-cylinder Junkers engine is not yet in service. Installed in the He 177 Bomber, the question is raised whether the D.B. 606 engine is also fitted to the Me 115 fighter. *Flight*, March 18, 1943, page 279, 2 illus.

Calculation of Proportional Cams for Internal Combustion Engines. E. Rossner. The proportional cam is widely used for intake and exhaust valve actuation in designs where space and weight limitations play an important part, as in airplane engines and auxiliary engines for airplanes. It is explained that the advantage of this type of cam is that under similar conditions the acceleration of the spring-loaded sector is smaller than with the conventional cam, thus permitting the use of a smaller spring or a higher lift with the same spring. With the proportional cam, the cam contour must be so laid out that a constant relation is maintained between the spring force and the inertia force of the valve masses. The writer gives detailed information on the design requirements and layout of proportional cams. *Automotive and Aviation Industries*, May 1, 1943, pages 38–40, 3 illus.

They're Both Good. A. Dawydoff. A brief discussion of the relative merits of liquid-cooled and air-cooled engines is accompanied by illustrations showing important features of both methods of cooling. It is pointed out that many arguments on the subject of liquid- versus air-cooling show a misinterpretation of fundamentals. *Air Trails*, May, 1943, pages 21–23, 13 illus.

POWER from Pistons to Props. Roland H. Spaulding. Preceded by an explanation of the principles of aircraft engines and how they function, this is a compendium of illustrations and data on various American aircraft engines and one British type. In the "light" air-cooled division are shown several Lycoming, Continental, Rearwin Ken-Royce, Warner, Jacobs, Franklin, and Kinner models. The "heavy" air-cooled engines section contains Wright, Pratt & Whitney, and Ranger engines. The liquid-cooled engines include the Allison and British Rolls-Royce types. *Skyways*, May, 1943, pages 32–48, 51–60, 78 illus.

Gasket Material. The manufacture of gaskets for aircraft engines from a high tensile fibrous sheet material impregnated with phenolic plastics is described. It is explained that this gasket material has been under development since 1941 and is important in that it releases asbestos, synthetic rubber, and other limited materials for those uses for which there is no possible substitute. Although conceived as a supplementary material, it is stated to have proved superior to its predecessors in certain applications. It can be used on both liquid- and air-cooled engines. *Modern Plastics*, May, 1943, pages 78, 79, 156, 7 illus.

Motores Sobrealimentados (Supercharged Engines). Hugo Fuentes. It is stated that the efficiency of any conventional aircraft engine decreases with altitude. In order to have a proper fuel mixture it is necessary to use superchargers. Two types of superchargers, volumetric and centrifugal, are described. The volumetric superchargers are divided into the piston type and the Root's type. Their disadvantage is attributed to the imperfect adjustment between the wall of the housing and the rotor. The piston type is considered to be even less adaptable to aircraft engines because of the effect of inertia of its members.

The writer devotes the principal part of this first of a series of articles to centrifugal compressors. These are divided into those with direct drive from the crankshaft and those turbo-compressors that are actuated by the exhaust gases. He goes into details on compression ratio and speed ratio, absorbed and recovered power, and various types of clutches. *Revista de*

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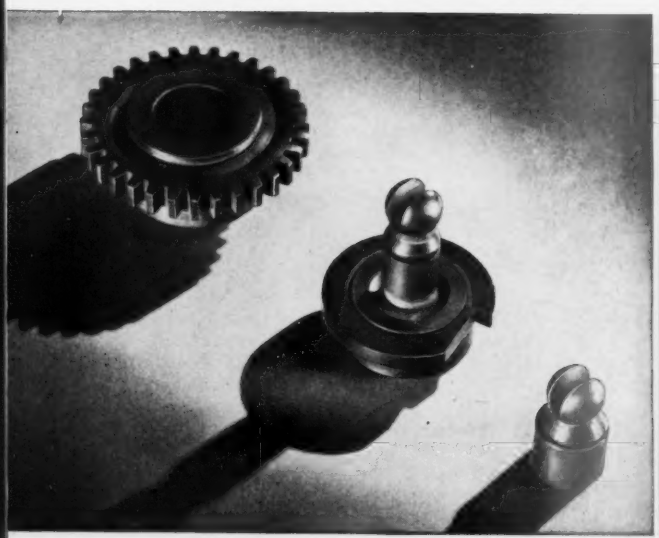

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la Fuerza Aerea, October-November-December, 1942, pages 25–36, 10 illus.

The Allison. William Levenor. The chronology of Allison engine development and the adoption of this liquid-cooled in-line engine by the United States Army for pursuit planes. Factors affecting decisions as to what type of engine to use in fighter aircraft are also surveyed.

The article reviews the features, background, development, and production (including subcontracting) of the Allison engine. It lists the different advantages of both liquid- and air-cooled engines and compares the Allison with liquid-cooled engines of European manufacture. It then shows the limitations upon powerplant design (especially as to the installation of supercharging and intercooling) which are created by the requirements of plane design and imposed by the tactical needs of specific aircraft. Several American and British fighter models are mentioned, together with the engines by which they are powered and the reason for each installation. *Flying*, May, 1943, pages 28–31, 84, 86, 89, 90, 92, 6 illus.

Jagdflugzeug und Sternmotor (Fighter Plane and Radial Engine). This article calls attention to the reversal of the trend in the construction of fighter planes. It is shown that, while for some years the air-cooled radial engine was not favored for this type of aircraft, it now has come to the foreground to compete with the liquid-cooled in-line engine. This change is found to be contrary to the general expectations. As late as the middle of 1940, fighter-plane design seemed to have adopted the in-line engine exclusively, as represented by the Messerschmitt Me 109, Heinkel He 113, Dewoitine De 520, Spitfire, and Hurricane. The writer states that even in the United States where the air-cooled radial engine had a substantial preponderance, the Tomahawk P-40 was equipped with the Allison 1710 of which, at that time, there were insufficient numbers on hand. The race between the air-cooled radial and the liquid-cooled in-line engine seemed to have been decided in favor of the latter.

The reasons for this decision and also for the current use of the radial engine are given. Advantages and disadvantages of both engine types are compared and the conclusion is reached that the outlook for the in-line engine is not so bright as it was formerly. However, this does not mean that it is expected to be discarded entirely. If signs are not misleading, modifications of the design of in-line engines are already noticeable, and it is possible that the solutions of

pending problems may be realized, but not soon enough to have any bearing on the present war status of the fighter plane. *Schweizer Aero-Revue*, October, 1942, pages 407–409, 4 illus.

Here's Your Horsepower. W. B. Courtney. Written for the layman, this is an explanation of some fundamental aircraft-engine design and production problems. Comparison with automobile engines forms a basis for interpretation. Among the factors that the writer gives as differentiating the aircraft engine from the automobile engine are those of weight, weight-power ratio, altitude problems, and carburetion. He also compares requirements and production methods of the Cadillac automobile engine and the Allison aircraft engine to show the necessity of finer finishing in the aircraft type.

Four engines of early United States aviation are noted: the Curtiss OX, the Liberty, the Hispano-Suiza, and the Whirlwind. The differences between air-cooled and liquid-cooled, radial and in-line, and current types of engines are defined and the manufacturers of each are named. Although he states that the United States aircraft-engine industry at this stage of development is committed to gasoline, the writer mentions the future possibilities of Diesel engines and jet propulsion. *Collier's*, May 1, 1943, pages 14, 15, 65, 66, 2 illus.

Flight Technique

Wingitis. John R. Peters. The writer discusses "pilot error" as a cause of aircraft accidents. The errors that pilots make are listed and some figures on the proportion of losses in the Army Air Forces due to pilot error are furnished. Suggestions for preventing accidents of this type are given. *Air Facts*, May, 1943, pages 26–30.

¿El Factor Homber Sera Siempre Una Incognita en el Accidente de Aviation? (Is the Human Factor Always Going to be an Unknown Quantity in Airplane Accidents?). Luis Vivanco. Excerpts from a paper that deals with airplane accidents and their causes, read at the Chilean Aviation School. The writer gives special consideration to the problem of the human factor, and actual accidents are cited and investigated, and deductions are made on their causes. He makes the following suggestions to reduce the influence of the human factor in airplane accidents to a minimum: (1) a minute fitness test of each individual and better flight training; (2) regulated medical control and adoption of official forms to be used as a summons for examination and for suspension of the license; (3) sufficient scientific notifications of these problems to be given to flight directors, instructors, and flight surgeons; (4) investigation of each accident, aided by technical advice of the aeronautical authorities; (5) a medical committee to study from year to year the progress made abroad in this matter. *Revista de la Fuerza Aerea*, October-November-December, 1942, pages 37–45.

The Rudder—Booby Trap for Fledglings. E. C. Bailly. The purpose of the airplane rudder and its action in making turns is described. The writer tells what a turn is, explains the important part the ailerons play in the making of turns, and describes the true purpose of the rudder. *Air Facts*, May, 1943, pages 39–44.

Some Notes on Cross-Wind Landings. Franklin T. Kurt. Cross-wind landing information for pilots is given. It is stated that there can be no trouble while the plane is still airborne and that contact problems are simple. In this case the solution is merely to have the plane pointing in the right direction. Three methods of landing are outlined and the control of the plane after landing is described. The writer discusses the air forces acting on a plane with standard landing gear as it is rolling on the ground, the forces acting after an upwind ground loop has started, and the landing and take-off paths. Diagrams clarify the description. *Air Facts*, May, 1943, pages 52–56, 10 illus.

Gliding and Soaring

Japan's Gliders. Information on some of the single- and two-seater training and high-performance gliders developed by the Japanese is tabulated. It is stated that Japan started glider production in 1937, that local materials are being used, and that the models strongly resemble German types.

Tabulated headings refer to the type, span, length, wing area, aspect ratio, empty and loaded weight, wing loading, and gliding angle. Gliders described are the Itoh C.6, Itoh D.1 (two-seater), Hikari Rokko 2, Hikari Rokko 1 (two-seater), Hikari (two-seater), Mayeda-Rokko 1, Sotoh T.C.,

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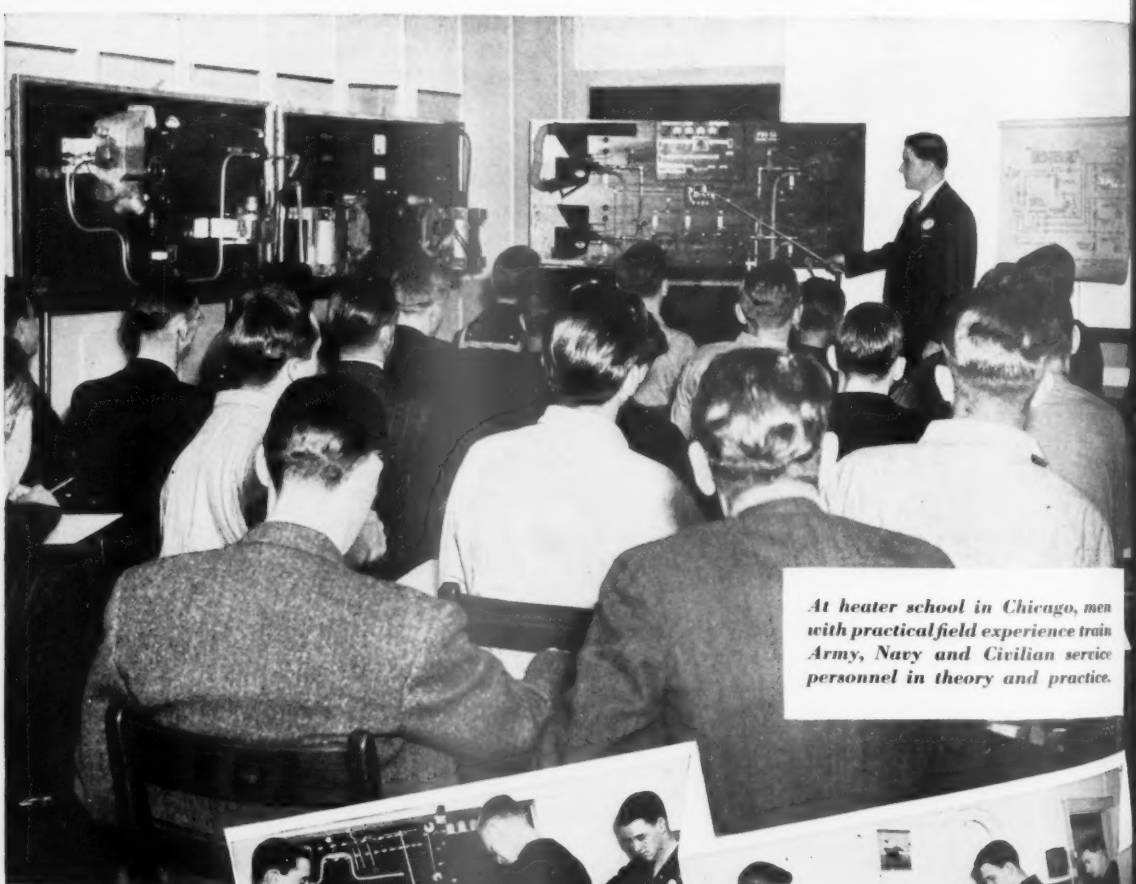

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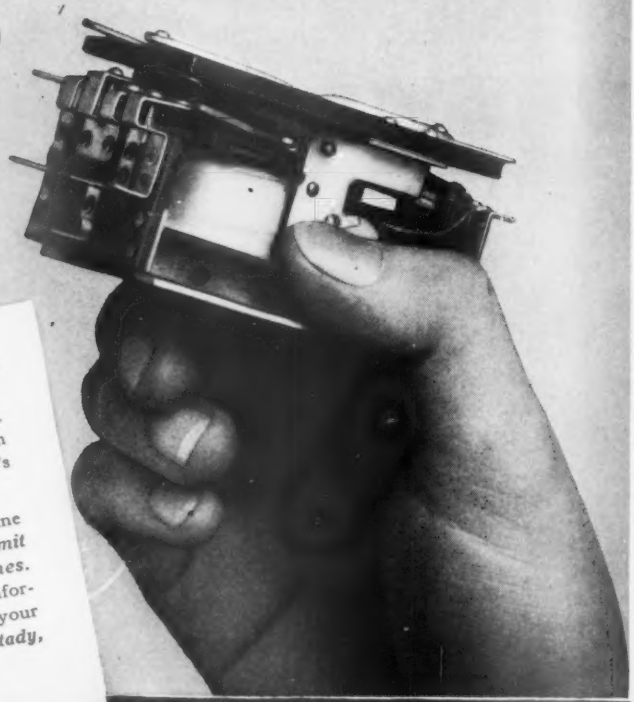

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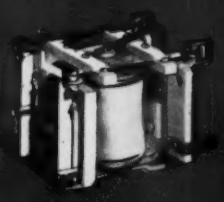

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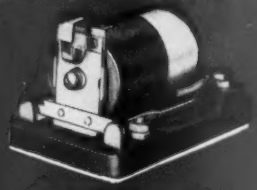

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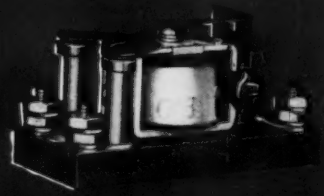

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Nippon Ohtori, Nippon Washi (two-seater). *Flight*, March 18, 1943, page 289, 3 illus.

Die neue voll-elektrische Startwinde der Segelfluggruppe Bern (The New All-Electric Starting Winch of the Berne Glider Group). O. Schurter. A description of a new all-electric starting winch for gliders, which is claimed to be the most perfect of its kind so far developed. Its special characteristics are listed as: powerful, nonjerky, elastic start; automatic adaptation to the actual speed of the glider; immediate speed control; and maximum safety of operation. Its efficiency, construction, motors, and transformers, as well as its operation, are described. It is stated that by means of this winch the glider start becomes an ideal one. *Schweizer Aero-Revue*, October, 1942, pages 394–396, 7 illus.

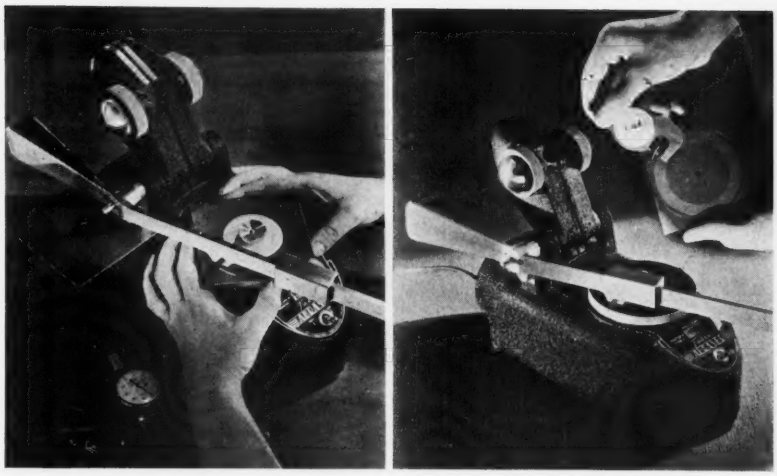
Soaring Into the Future. Capt. J. Shelly Charles. A brief discussion of the glider and its value in present and future military operations. The various steps in the development of the Army's glider program are traced, and some of the improvements in military glider design are referred to. It is noted that the Douglas DC-3, one of the standard airliners, is used as the tow plane for modern troop-transport gliders designed especially for military purposes. Possible uses of the glider in air commerce are considered. *Airlanes*, April, 1943, pages 7, 16, 1 illus.

High-Altitude Flying

High-altitude Flight. W. Nichols. The third and final installment of a series of articles on the problems connected with high-altitude flight from both commercial and military considerations contains observations on pressure-cabin design. It examines the shell design of the cabin and goes into detail about the pressure regulating valve and supercharger control unit. Some American and German practices are noted, and a table is included showing the effects of altitude upon various properties that influence aircraft performance. Among the topics particularized are the sealing of skin joints, the avoidance of bolt holes, and the Dunlop Seal. The study includes a description of the system used on the Boeing Stratoliner. *Flight*, March 4, 1943, pages 236–239, 8 illus.

History

Famous Flights That Failed. The writer gives a brief historic outline of early attempts to fly and of the advancement of aviation. Some early plane designs that proved impractical are illustrated. He states that most aeronautical engineers agree that today's achievements in aviation are more directly traceable to the ten-year period following the first flight of the Wrights than to the decade immediately preceding the outbreak of the war in Europe. *Air News*, April, 1943, pages 26, 27, 62, 5 illus.



The Taber abraser shear hardness attachment. (*See* page 163.)

Inspection

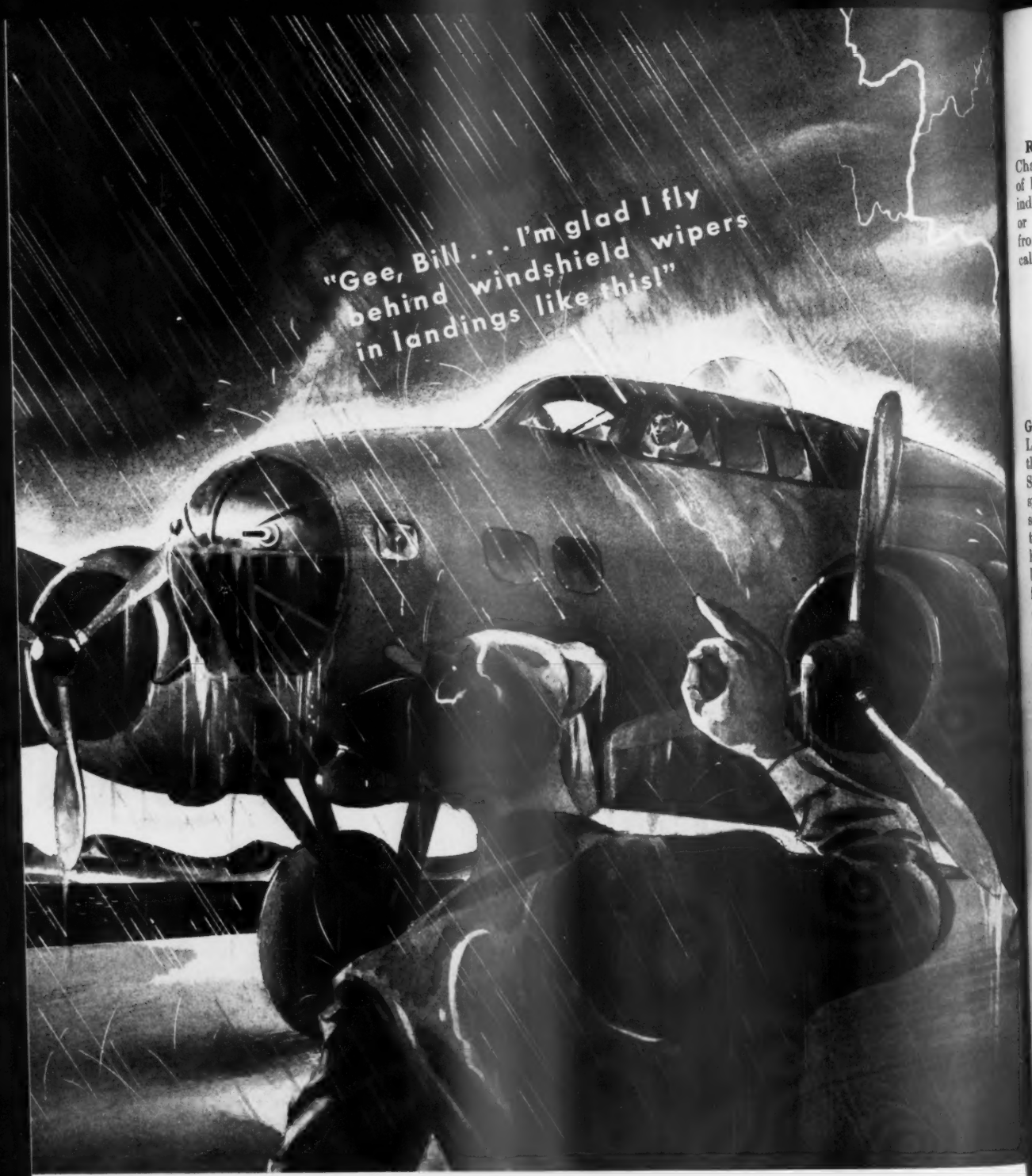
Radiography of Aircraft Castings. Robert Taylor. The extension of radiographic inspection to light alloy castings is described. The factors governing x-ray examination, in which control must be precise, are broadly classified into exposure factors and sensitivity, and the points under exposure factors are listed as potential, milliamperage, time, and focus film distance. It is essential that the degree of sensitivity be a known factor in order to establish the size and location of a small defect. The desired exposure conditions are summarized from the findings resulting from research at the National Research Laboratories at Ottawa. Examples are described of radiographic work with metals of a thickness ranging from $^1/_2$ to $^3/_4$ in., with comments on correct exposure and development. The requirements of Army Air Forces specifications are discussed and instruction is given for complying with these specifications. It is indicated that for the greater portion of aircraft castings a brighter type of illumination is required than the ordinary fluorescent type, a description being given of the construction of such a device.

A general summary of information obtainable from radiography is as follows: determination of gas inclusions; determination of slag inclusion; porosity of metal; shrinkage cracks; relationship of fault to total size; homogeneity; dross; segregations; miss-runs; cold shuts; correction of mold temperature; proper grading of pattern; and correction of faults in casting procedure. The article concludes with the definitions of the four classes of castings by which radiographic interpretation is governed. *Aero Digest*, May, 1943, pages 238, 240, 264, 265, 3 illus.

A Rapid Gamma-Ray Inspection Technique. Robert C. Woods. In this article on Gamma-ray inspection technique the writer describes a screen setup that is stated to speed materially the Gamma-ray inspection process. Problems connected with decreasing the exposure time are discussed and details of the new method are set forth. Diagrams are provided to clarify the explanation and radiographs of parts are shown. *Metals and Alloys*, April, 1943, pages 764–766, 5 illus.

Instrument Flying

The Elusive Cone. Robert N. Buck. The proper technique for bringing an airplane to the airport by means of radio signals is described, and factors that may cause the pilot to miss the cone are discussed. The volume of the signal from the range station builds up rapidly as the plane gets nearer to the station. This brings a nervous reaction that tends to upset emotionally the inexperienced pilot, and the writer explains the proper method of controlling the volume to avoid this nerve reaction. How the making of under corrections and over corrections will cause a pilot to miss the cone is described. *Air Facts*, May, 1943, pages 45–51, 2 illus.



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Instruments

Relation of Height to Pressure. Charles Williams. An analytic study of how corrections can be applied to indicated aircraft altitudes when one or more factors is known to differ from the standard value adopted for calibration. This is worked out according to mathematical formulas. Following the equations for altimeter calibration, methods and limits of correction are detailed. Although the main formulas are based on an assumption that the lapse rate remains constant, the effect of changes in the lapse rate is also considered. *Flight*, March 11, 1943, pages 261, 262.

Maintenance

Aircraft Service Organization the Gateway to Sound Operation. Arthur L. Fornoff. This article deals with the organization of Bell Aircraft's Service Division, its function, training system, methods of operation, and some of the problems it is called upon to solve. The writer also explains how the summary of reports sent in by the service men from the fighting front, duly analyzed, forms the basis of information for future design of aircraft. An illustrative chart gives a visual plan of the department's organization. *Aviation*, April, 1943, pages 211–213, 355, 356, 359, 5 illus.

Aircraft Inspection. As told to Herb Packer. Information on how to make a 100-hour periodic check on an Ercoupe is given. It is stated that, while the article has particular reference to the Ercoupe, most of the information can be applied to any light airplane. The writer explains how to check the engine and engine mount, shock absorbers, wings, fuselage, seats and upholstry, and instruments. The article is intended to cover only the essential points, the mechanic being advised to refer to the bulletins issued by the aircraft manufacturer and by the C.A.A. *Aviation Service Magazine*, March-April, 1943, pages 8–16, 7 illus.

Need Seen for Powerplant Test Stand. E. J. Foley. The writer suggests tests runs of the entire nacelle assembly, including engine, cowling, propeller and accessories, on a special "operating test stand." The relative advantages of portable and stationary test stands are considered. The location of the overhaul base is discussed and the timesaving possibilities of the new method are studied. *American Aviation*, May 1, 1943, page 52, 1 illus.

Saving Undercarriage Tyres. "Watchkeeper." Maintenance suggestions are given for prolonging the usefulness of airplane tires. The operation of the Schrader valve is explained. Correct procedures for removing and fitting inner tubes are outlined, and methods of checking air pressures are noted. *The Aeroplane*, March 12, 1943, page 300.

How One Dead Plug Can Melt a Piston. The care of the spark plugs and combustion chambers of aircraft engines is outlined, and troubles that may be caused by a faulty spark plug are described. The writer explains how one dead spark plug in a twin-ignition engine may cause detonation that will result in excessive heat and a damaged piston. *Aviation Service Magazine*, March-April, 1943, pages 20, 21, 24, 2 illus.

Repaired to Fly Again. Air Commodore C. W. Weedon. The salvage and repair of damaged aircraft as carried out by the Royal Air Force are described. It is explained that, even when aircraft are damaged beyond repair, salvage is of vital importance both as a source of raw material and as an aid to research development. Allied aircraft are restored to service and enemy craft are analyzed. Following an accident, intelligence officers and engineers decide on the action to be taken by the repair and salvage unit. Repairs may or may not be made on the spot, depending upon the conditions. Because sea water causes rapid corrosion of light alloys, the salvage of aircraft from the sea must be completed with the utmost speed. Mobile equipment used to salvage planes is described. *Indian Aviation*, December, 1942, pages 304, 306, 1 illus.

Aircraft Cable Splicing. A. R. Foil. This article gives instruction on how to make aircraft cable splices that will pass the C.A.A. inspection. The equipment required for splicing the cable is described. The technique of splicing is explained with the aid of illustrations. *Aviation Service Magazine*, March-April, 1943, pages 26–30, 32, 33, 12 illus.

Management

Efficient Production Management Achieved by Careful Controls. Part I. C. H. Speck. This first of a series of articles on production management deals with an efficient control system, depicts the scope of the Production Manager's duties, and outlines the functions of the departments working under him. It shows how production records are compiled and how a steady flow of materials, parts, subassemblies, and finished products is maintained through the factory. An analysis is presented on each of the following subdepartments: Production Planning, Production Control, and Material Control.

Planning procedure is detailed, the preparation of a shop order is described, and the release of a production order is followed through its various steps. A system used by one factory for assigning order numbers when releasing an order on a contract basis is also explained.

The article contains illustrations of various forms: engineering release sheet, master specifications sheet, production order, material requisition, etc. It also contains a chart showing the breakdown of the Production Control and Production departments. *Aero Digest*, April, 1943, pages 184–186, 207, 208, 11 illus.

Manufacturing Equipment

Proper Care of Compressed Air Plants. Ed C. Powers. Fundamental precautions are suggested for increasing the efficiency and durability of the compressor, air lines, intercooler, aftercooler, and receiver units of a compressed air system. Proper methods of cleaning, checking, lubricating, and operating are described and effective cleaning and lubricating agents are designated. The article recommends daily, weekly, and monthly inspection routines to cover cooling system, lubrication, valves, and packing. In addition to an oil feed rate table, diagrams of various compressed air plant parts are shown. *Aviation*, April, 1943, pages 179, 180, 389, 390, 8 illus.

Materials

Aviation's Place in the Controlled Materials Plan. John Foster, Jr. A discussion of the Controlled Materials Plan as it applies specifically to the aircraft industry. Certain modifications, considered necessary by the industry for the success of the plan, are explained. The article also contains a summary of 18 questions (said to be the most frequent inquiries) about the Controlled Materials Plan, together with answers as worked out by W.P.B. officials sitting in round-table discussions with representatives of the armed forces and the aircraft industry.

It is stated that, although aviation manufacturers believe the Controlled Materials plan to be fundamentally sound, they feel it is utterly impossible

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to maintain quantity production on "the three months-to-three months basis" of the plan as it stands currently. Their suggested modifications reported by the articles are for redistributing materials more speedily and simplifying the compilation and filing of bills of materials by setting up a group of so-called "average planes."

In tabulated form at the beginning of the article, the following terms relating to Controlled Materials Plan are defined: Controlled Materials, Bill of Materials, Claimant Agency, Requirements, Allotment, Prime Consumer, Secondary Consumer, and Authorized Schedule. *Aviation*, April, 1943, pages 114, 115, 378, 381, 382, 385, 386, 389, 2 illus.

Properties of Magnesium Alloys as Affecting Design and Fabrication. Kurt Renner. This summary of the properties and further development of magnesium alloys, which is intended for the designer and practical engineer, is based on an article in *Luftwissen*. The important components of magnesium alloys are mentioned, and methods of manufacturing Elektron alloy bars, profiles and tubes are described. The strength and deformation properties of magnesium alloys are also given. It is explained that because of the excellent properties of Elektron alloys they are extensively used for stampings and forgings. Elektron sheet metal alloys are classified. Fabrication is discussed under sections covering cold-working, hot-working, riveting, welding, and soldering. Other sections of the article discuss the jointing of Elektron with other materials, corrosion properties, and the fields of application of Elektron alloys. *Sheet Metal Industries*, April, 1943, pages 651–657, 8 illus.

Medicine

The Relationship of the Eye to Anti-Aircraft Gunnery. Capt. Erwin E. Grossmann. The writer shows the value of scientifically selecting anti-aircraft gun crews with regard to ocular efficiency and how such selection can be expediently effected. After discussing the special and stereoscopic requirements of Air Corps and Height Finders Schools, he reports how similar tests were extended to the gun crews at Camp Hulen Anti-Aircraft Training Center and lists the conclusions arrived at from the experiment.

Based upon a combined selection of tests taken from those of the Height Finders School and Air Corps, the Camp Hulen examination stressed the sense of depth perception and its modifying factors. The factors—external eye pathology, inequality of vision, inequality of the refractive error, color vision, muscle imbalance,

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FOR GENERAL MACHINE SHOP PRACTICE

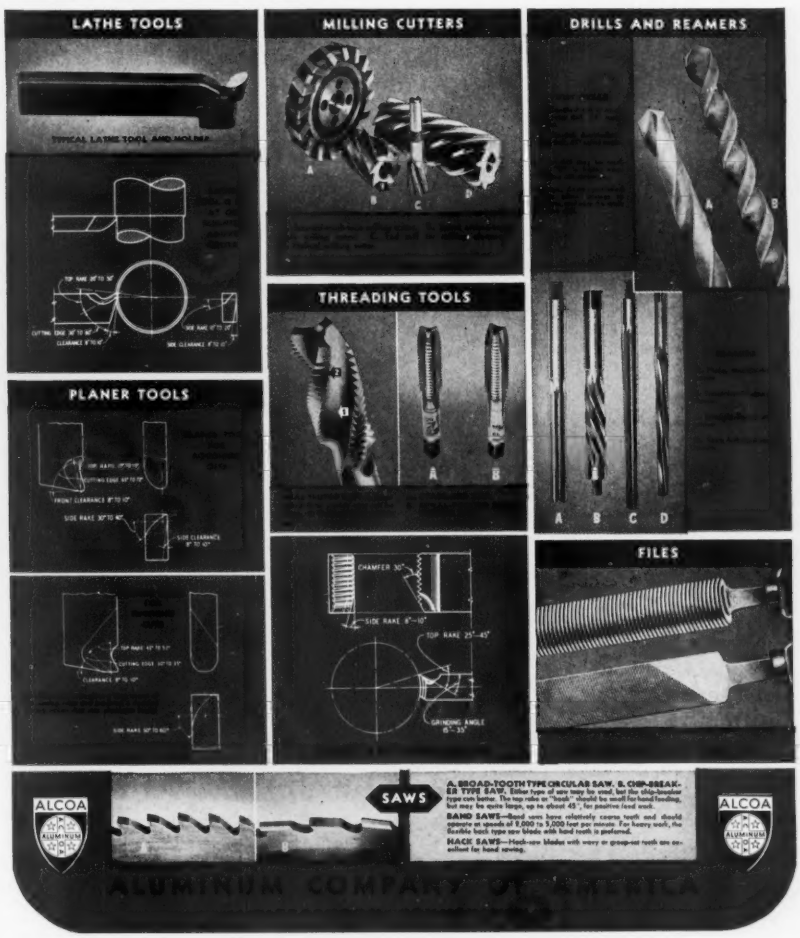
TOOLS for machining aluminum should generally have more top and side rake than is common for machining steel; the cutting edges should be keen and the tool surfaces should have a smooth, bright finish.

In the following illustrations, a wide range of rake angles is indicated. In general, the larger rake angles are employed for finishing tools and for the aluminum alloys that are not free-cutting; this includes the softer materials which require tools with exceptionally acute and keen cutting edges. On the other hand, rake angles in the lower range are used for roughing cuts and for machining the alloys that have free-cutting characteristics. Tools similar to those used for machining steel may often be employed successfully.

TOOL MATERIALS—High-carbon steels are good for many jobs where the cutting speed is low. High-speed tool steels are better for quantity production. Cemented-carbide-tipped tools are superior to high-speed tool steels, especially for aluminum alloys with a high silicon content.

CUTTING SPEEDS AND FEEDS—Generally, aluminum can be machined to best advantage by using the highest speed at which the equipment is capable of operating, with moderate feeds and cuts.

CUTTING COMPOUNDS—Use a copious amount of cutting compound. Soda water or soluble oil may be used for milling, drilling, and sawing operations. Mineral oil with the addition of 5 to 10 per cent fatty oil, such as lard oil, is an excellent lubricant. A 50-50 mixture of kerosene and lard oil gives excellent results.


LATHE TOOLS
TYPICAL LATHE TOOL AND HOLDER
MILLING CUTTERS
DRILLS AND REAMERS
THREADING TOOLS
PLANER TOOLS
FILES
SAWS
A. BROAD-TOOTH TYPE CIRCULAR SAW. B. CHIP-BREAKER TYPE SAW. Either type of saw may be used, but the chip-breaker type cuts better. The top rake or "hook" should be small for hand feeding, but may be quite large, up to about 45°, for positive feed work.
BAND SAWS—Band saws have relatively coarse teeth and should operate at speeds of 2,000 to 5,000 feet per minute. For heavy work, the flexible back type saw blade with hard teeth is preferred.
HACK SAWS—Hack-saw blades with wavy or group-set teeth are excellent for hand sawing.
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and internal ocular pathology—are treated by the writer at length, with emphasis placed on the respective influence of each. In recording the results of the examination, he relates the visual requirements that were designated as desirable for efficient performance with gun crews. The clinical conclusions as to the essential qualifications for antiaircraft gunner are that it calls for: (1) the ability to appreciate a depth under laboratory conditions of at least 30 sec. of the arc and (2) great promptness of fusional movements in the horizontal plane.

The article also reports that an optical instrument for increasing the effective stereoscopic range to about 1,500 yards has been devised at Camp Hulen. It is stated that this apparatus incorporates the principles of the Height Finder but on a smaller scale and at a much less prohibitive cost. *The Military Surgeon*, April, 1943, pages 383–393.

Flying Medicine Men. Lt. (j.g.) John B. Goodman. The duties of the Flight Surgeon of the Navy's Medical Corps and how he is trained to perform them are described. The causes of flying fatigue are discussed and the symptoms of this condition are listed. The effects of changes in altitude and temperature on the pilot and crew of aircraft are considered. Reference is also made to the use of preventive medicine as a means of reducing casualties. *U.S. Air Services*, April, 1943, pages 21, 22, 46, 3 illus.

Cause and Prevention of Physical Disturbances. This is the third of a series of articles on the selection of combat pilots. The writer describes how changes in the blood pressure brought about by centrifugal force cause disturbances in the blood flow in the retina of the eye and in the brain which may affect vision and result in loss of consciousness. He also lists the important points in a medical examination for flying fitness. *Aircraft*, March, 1943, pages 29, 30, 2 illus.

Metallurgy

The Metallurgy of Modern Alloys. R. H. Harrington. In the fourth installment of a series of articles discussing heat-treating definitions, the writer considers the classification of general types of equilibrium diagrams, the general factors that lead to building these diagrams, the principles involved, and the relationship of the diagrams to the inherent properties that result from the alloying of metals.

The fifth installment continues this discussion. Diagrams coordinating typical cooling curves and equalitative physical properties with each type of binary equilibrium diagram are shown. *Heat Treating and Forging*, March, 1943, pages 132, 133, 148; April, 1943, pages 179–182, 206, 10 illus.

Meteorology

Wartime Weather Prophets. Leonard Engel. United States Army Air Forces weather forecasting is discussed. It is explained that the Army Air Forces meteorologic organization is the Directorate of Weather, which is directly under the Air Staff. The rapid growth of the Weather Directorate during the past three years and its world-wide operations are reviewed. Its two main functions are stated to be the furnishing of meteorologic data needed for airplane operations and the making of long-range forecasts for the General Staff and others engaged in preparing battle plans. The writer shows that forecasting and reporting are based largely on a combination of two techniques, one of which is air-mass analysis and the other the analysis of weather sequences of the past as a clue to what is to happen in the near future. Forecasting methods are discussed. *Air News*, pages 10–13, 50, 15 illus.

Military Aviation

Problems of Global Air War. Lt. Col. Nathaniel F. Silsbee. Many problems connected with global air warfare are discussed, and how the Army Air Forces have been distributed to widely scattered fronts is described. It is stated that the greatest single reason for the remarkable spread of American air power within a few months is the phenomenal growth of the Air Transport Command, which, taking advantage of the experience of domestic air lines, has developed four great airways and has become the world's biggest air line in terms of distance and traffic. A considerable part of the article is devoted to a discussion of warplanes and the services they perform. Some tabulated information on comparative plane performance is given. *Mechanical Engineering*, May, 1943, pages 313–320, 6 illus.

The Red Air Fleet Two Years After. Lucien Zacharoff. The progress of Soviet aviation is appraised. To determine the secrets of Soviet success in the air, the writer interviewed Col. Paul Berezin, one of Russia's experienced aviators and now Assistant Military Attaché to the Washington Embassy of the U.S.S.R. Factors that contributed to the current effectiveness of the Russian air force are outlined. *Air-Age*, June, 1943, pages 6–9, 72–74, 5 illus.

Apuntes de Tactica Aerea (Notes on Aerial Tactics). Felix Olmedo. This second of a series of articles discusses the form and size of combat formations, the type of formation, and the principles that govern the size of formation. Other subjects treated include night fighting, attack against fast-moving ships, and opportunities for attack or for evasive maneuvers. *Revista de la Fuerza Aerea*, October-November-December, 1942, pages 10–16.

Our Six-Continent Air Force. George S. Devereux. The writer describes the global activities of the Army Air Forces and tells how American warplanes are performing in the different theaters of the war. Developments are traced from the time the United States entered the war up to the present. *Air-Age*, June, 1943, pages 14, 15, 70, 3 illus.

Submarine Smashers. Charles Ewing. The work of America's Anti-Submarine Command is described and the various operational phases are discussed. In considering the types of aircraft suited for action against enemy U-boats, particular mention is made of the North American B-25 Mitchell, which is stated to be used extensively by the Bomber Command because of its great bomb-load capacity. Figures are given on the speed, range, and bomb-load capacity of this plane. The day's activities at a typical antisubmarine base are recounted and the duties of the pilot and crew are given. *Model Airplane News*, May, 1943, pages 6, 7, 60, 62–64, 8 illus.

Fighting French Flyers. Rene Kahn. In what the writer calls an episodic tale he describes how former members of the Armée de L'air have come to England by devious routes to join the Fighting French air force. The information was compiled largely from the archives of the Fighting French air force. It reviews the accomplishments of that unit and the services now being performed by the men. *Air-Age*, June, 1943, pages 27, 28, 64, 5 illus.

Naval Aviation

The Carrier Question. Leonard Engel. That carriers are undergoing extensive changes in design but are not being eliminated from the shipbuilding programs of either the Allies or Japan is explained in this article. It is stated that long-range bombers will never eliminate the sea-going airdrome because of the time advantage that carrier-based aircraft give to a fleet. An analysis is made of the number of aircraft carriers that are being built by the Allies and the enemy, and the writer also gives information on the

More information on Du Pont "Lucite" methyl methacrylate resin sheeting for aircraft designers, engineers, and their established transparent enclosure suppliers.

What influences the impact strength of Du Pont "Lucite"?

The impact strength of Du Pont "Lucite" compares favorably with that of other plastics used for aircraft enclosures. At 77°F and 50% relative humidity, impact strength is, by Charpy method, 0.30-0.50 foot-pounds, and by Izod method, 0.25-0.40 foot-pounds per inch of notch. However, factors outlined below which modify impact strength should be considered in designing enclosures of "Lucite."

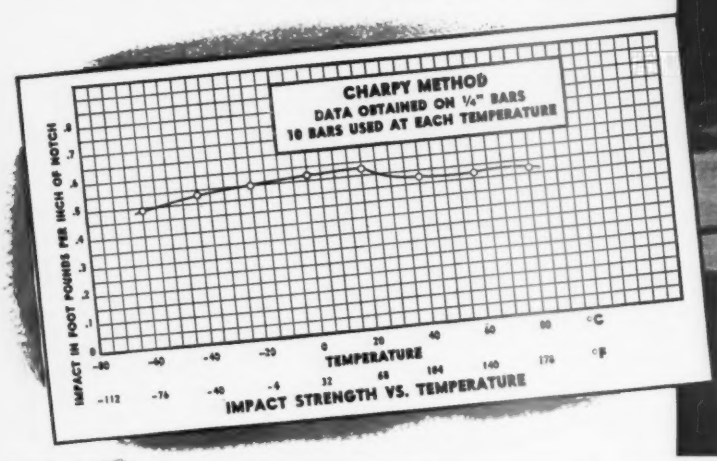
TEMPERATURE—The single-blow impact strength of cast "Lucite" remains almost constant over a wide range of temperatures. (See Graph.)

FATIGUE—Impact strength decreases under repeated impacts to between 40% and 60% of its initial, single-blow value.

MOISTURE—The impact strength of cast "Lucite" is little affected by water. Identical test bars soaked in water for several days, then broken at high and low temperatures, show no significant change in impact strength.

ORIENTATION—Impact values may be affected considerably by alignment of molecules—orientation—caused during forming operations. Impact strength decreases in one direction and increases in the perpendicular direction.

CONTOUR OF FINISHED ARTICLE—Surfaces of "Lucite" sheeting should be finished smooth, and fillets of large radii used when design calls for sharp bends. Surface irregularities introduce high stresses. If stress concentration at these points exceeds the single-blow impact strength, failure will occur from a single blow.



"LUCITE" IN USE—The famous Boeing B-17 Flying Fortress built by Vega carries many crystal-clear transparent parts made of Du Pont "Lucite," including top and belly-gunner's turrets and the nose-piece shown here.

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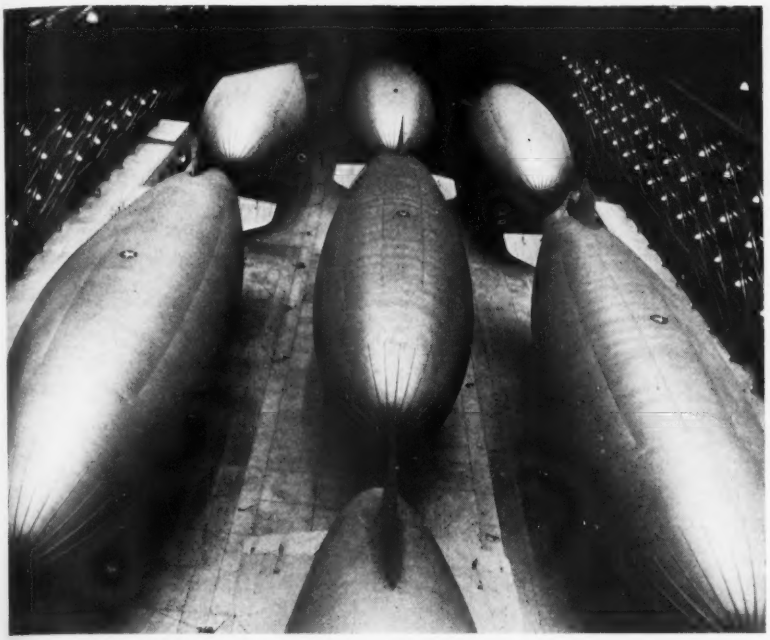


This official U.S. Navy photograph, taken inside one of the great airship hangars at an East Coast base, shows parts of seven nonrigid patrol airships used by the Navy's antisubmarine arm.

number of carriers that have been sunk. *Air Trails*, May, 1934, pages 14, 15, 58, 60, 61, 1 illus.

Salute to Shagbats. Fougueux. The operational record of the Fleet Air Arm's Supermarine Walrus is reviewed. Although its range limitation is acknowledged, the flexibility and utility of this amphibian biplane for many different types of jobs are stressed. The application of the Walrus on many fronts and in many climates for sighting raiders, antisubmarine patrol, escort trade-protection, reconnaissance, communications, bombardment spotting, and as an air/sea rescue plane is discussed. *The Aeroplane*, March 19, 1943, pages 329–331, 5 illus.

Battle of Bismarck Sea a Vindication of Air Defense. Comdr. A. F. Bonnalie. The writer discusses the place of aircraft in sea power as revealed by 15 months of intensive naval war. It is found that the effect of aircraft has been to augment and extend sea power and to add a most potent defense against sea power, rather than to replace it entirely. The part played by the air forces in the various great naval battles of the war is described in detail and what has been learned from these battles is reviewed. *U.S. Air Services*, April, 1943, pages 13, 14.

Today's Aircraft Carriers. Bruno Gruenwald. Some of the tactical inadequacies of aircraft carriers are indicated in this discussion of carrier design. The characteristics of different classes of carriers—as typified by German, Japanese, British, Russian, and United States models—are studied briefly, and the greater vulnerability of smaller carriers is demonstrated. Accompanying the article is a tabular summary that illustrates the comparative characteristics of the five main carrier classes active in this war.

The following tactical deficiencies are subjected to examination: difficulty in localizing torpedo hits; susceptibility to the danger of having main flight decks damaged; and great dependency on weather conditions. The writer expresses the opinion that the larger carriers are superior to the smaller ships. *Flying*, May, 1943, pages 38–41, 4 illus.

Eleven Hours to Nowhere. William D. Strohmeier. The writer's experiences on an eleven-hour submarine-hunting patrol in a Navy PBY. His comments touch upon certain features and operational qualities of the PBY-5a. The equipment of the airplane is described, as well as the work performed by different members of the crew. The action during a practice drill is followed to show what would have happened if the airplane had sighted a submarine. *The Sportsman Pilot*, April, 1943, pages 9–11, 38, 40, 5 illus.

The Goldfish Club. A report on the formation of a club for Royal Air Force airmen whose lives have been saved by collapsible dinghies is supplemented with a description of a new single-seat type of dinghy. The described dinghy is said to afford more protection from adverse weather and provide for the stepping of a collapsible mast. A general arrangement drawing of the dinghy is included in the illustrations of the article. *The Aeroplane*, March 26, 1943, pages 358, 359, 10 illus.

Parachutes

Parachutes, Paratroops and Parasuits. The evolution of parachute tactics in war is traced. Following a historical outline of the development of the parachute is a description of the modern parachute and equipment and how they are used. Sections of the article discuss the preparation for landing, delayed drops, supply dropping, and R.A.A.F. methods. *Aircraft*, March, 1943, pages 10–13, 10 illus.

Personalities

He Wants to See American Life Aviationized. T. N. Sandifer. How Hugh Fenwick, Vice-President of the Consolidated Vultee Aircraft Corporation, watched the transition of dive-bombing attacks abroad and returned to help give his own country a better weapon. It is noted that dive bombing was originated by pilots of the U.S. Navy but was picked up in theory and perfected in practice by other countries. The A-35 Vultee bomber is described as incorporating tactical and performance characteristics essential for world-wide usage. Mr. Fenwick's activities in aviation are outlined. *U.S. Air Services*, April, 1943, pages 15, 49, 1 illus.

Personnel

Absenteeism . . . What's the Problem? An account of how the aircraft industry is taking the national lead in investigating the causes of absenteeism and curing them. The major causes of absenteeism are reviewed, and methods adopted by the industry for minimizing or eliminating each type of problem are reported. As outlined by the Interdepartmental Subcommittee on Absenteeism set up by the Federal Government, three general classifications of causes are listed: (1) in-plant problems, subdivided into fatigue, job morale, inadequate personnel policy on absenteeism, and in-plant accidents; (2) individual employee problems, including illness, accidents outside the plant, home responsibilities of women workers, general lack of morale (separate from job morale), job shopping, lack of need for the pay check, and leisure; (3) community conditions, embracing

problems such as inadequate housing, inadequate transportation, rationing and draft board problems, inadequate shopping and service facilities, inadequate child care facilities, inadequate health facilities, and inadequate recreation facilities.

In addition to the industry's efforts as a whole (working through their Production Councils) to combat absenteeism at the source, specialized problems and treatments of individual plants are described. These include causes of action pursued by the following companies: Beech Aircraft, Bell Aircraft, Curtiss-Wright Airplane Division, Brewster Aircraft, Consolidated Vultee, Douglas, Lockheed, Glenn L. Martin, North American, Northrop, Ryan, and Vega. *Aviation*, April, 1943, pages 116, 117, 333, 334, 337, 3 illus.; "Industry Taking Steps to Control Absenteeism," Leslie V. Spencer, *Aero Digest*, April, 1943, pages 135, 136, 157–159, 278, 281, 282, 285, 286, 289, 290.

Selection of Labour. Points that should receive consideration in maintaining the physical fitness and efficiency of labor at the highest possible level are itemized. The relation between physical fitness and type of occupation is discussed, and functions of the works medical department are outlined. *Aircraft Production*, April, 1943, pages 170, 171.

Photography

Spotting Bombs with a Slidefilm Projector. Major D. H. Siegfried. The complicated procedure used to spot bombs dropped from aircraft before the Type C-3 bomb-spotting projector was developed is outlined. When a bomb fell, the location of the puff of smoke was determined by triangulation from three observation towers, placed at a safe distance from the target. In each station a line was established to the impact from the known position of the tower by an observer and, by plotting the three lines, the exact position of the burst was determined. This procedure had to be repeated for each bomb. The development of a method of photographing bomb bursts from the airplanes that dropped the bombs and projecting the resulting films on a screen in order to tabulate results is described. The various problems that had to be solved in the development of the camera and projector are reviewed. *Visual Review*, 1943, pages 26–29, 2 illus.

There's More to it Than Meets the Eye. The use of the aerial camera in warfare is described. The writer explains how reconnaissance pilots photograph camouflaged areas and outlines the way photointerpreters interpret pictures with the aid of the stereoscope and other equipment. Methods of camouflage used to keep the interpreter from drawing the right conclusion about what goes on at an airfield are described. *Canadian Air Cadet*, April, 1943, pages 12, 13, 25, 28, 5 illus.

Plants

Mistakes Made in Fighting Fires. Henry E. Heigis. The proper choice and use of fire-extinguishing equipment for industrial plants are discussed. Common fire hazards existing in service shops are defined. The importance of purchasing fire-fighting equipment of the right type and capacity is emphasized. A description is given of the various types of fire extinguishers and the purposes for which they are built. The methods used in fighting different types of fires and the incorrect methods to be avoided are discussed. *Commercial Aviation*, March, 1943, pages 99–101, 4 illus.

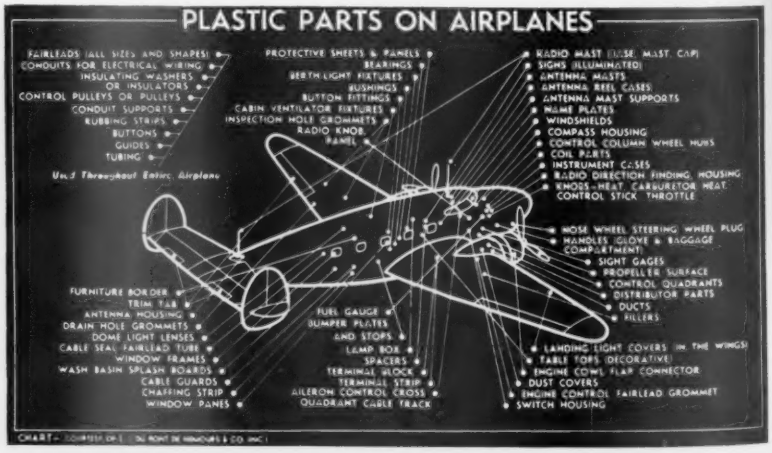
Plastics and Plywood

The Postwar Role of Plastics. John Delmonte. In a general discussion of the postwar future of plastics the writer notes that the present need for raw materials has brought realization of the possibilities of plastics in industry. The versatility of plastics and the ease with which they lend themselves to combination with other products are emphasized. It is stated that the war has made aircraft companies plastic minded, largely because of the strategic importance of aluminum. The prediction is made that after the war plastics and resin-bonded laminates will have to compete with a large aluminum output, which will probably be cheaper than ever before. *Modern Plastics*, April, 1943, pages 59, 142, 144, 146, 148, 150.

Behavior of Plywood Under Repeated Stresses. Albert G. H. Dietz and Henry Grinsfelder. Some of the results obtained in a continuing program of research into the behavior of plywood and laminated wood of both normal and high density are reviewed. The article deals with normal-density plywood and laminated wood, bonded with thermosetting phenol-formaldehyde resin, and with cold-setting urea-formaldehyde resin. It is shown that the rapidly increasing use of plywoods bonded with synthetic-resin adhesives has made imperative a study of both wood and adhesives under vibrating loads. Aircraft engineers require information on what allowable stresses may be employed for various loading conditions and what the endurance limit may be. *Transactions of the A.S.M.E.*, April, 1943, pages 187–191, 8 illus.

Points on Plastics in Aircraft Engineering. Part I. John Sasso. This is the beginning of a three-part article on the engineering and production of plastic components for aircraft. Part I provides a study of the fundamental characteristics of certain groups of plastics and their applications to aircraft and also presents the factors to be considered when designing an aircraft material. These are: (1) physical, thermal, electrical, and chemical properties; (2) design limitations of the plastic material; (3) economy of production; and (4) the cost of the plastic product in relation to other materials.

In the survey of plastic groups, phenolic resins, urea-formaldehydes, acrylic resins, polystyrene, vinyl copolymer, cellulose acetate, and vinyli-



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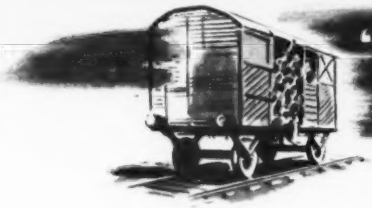

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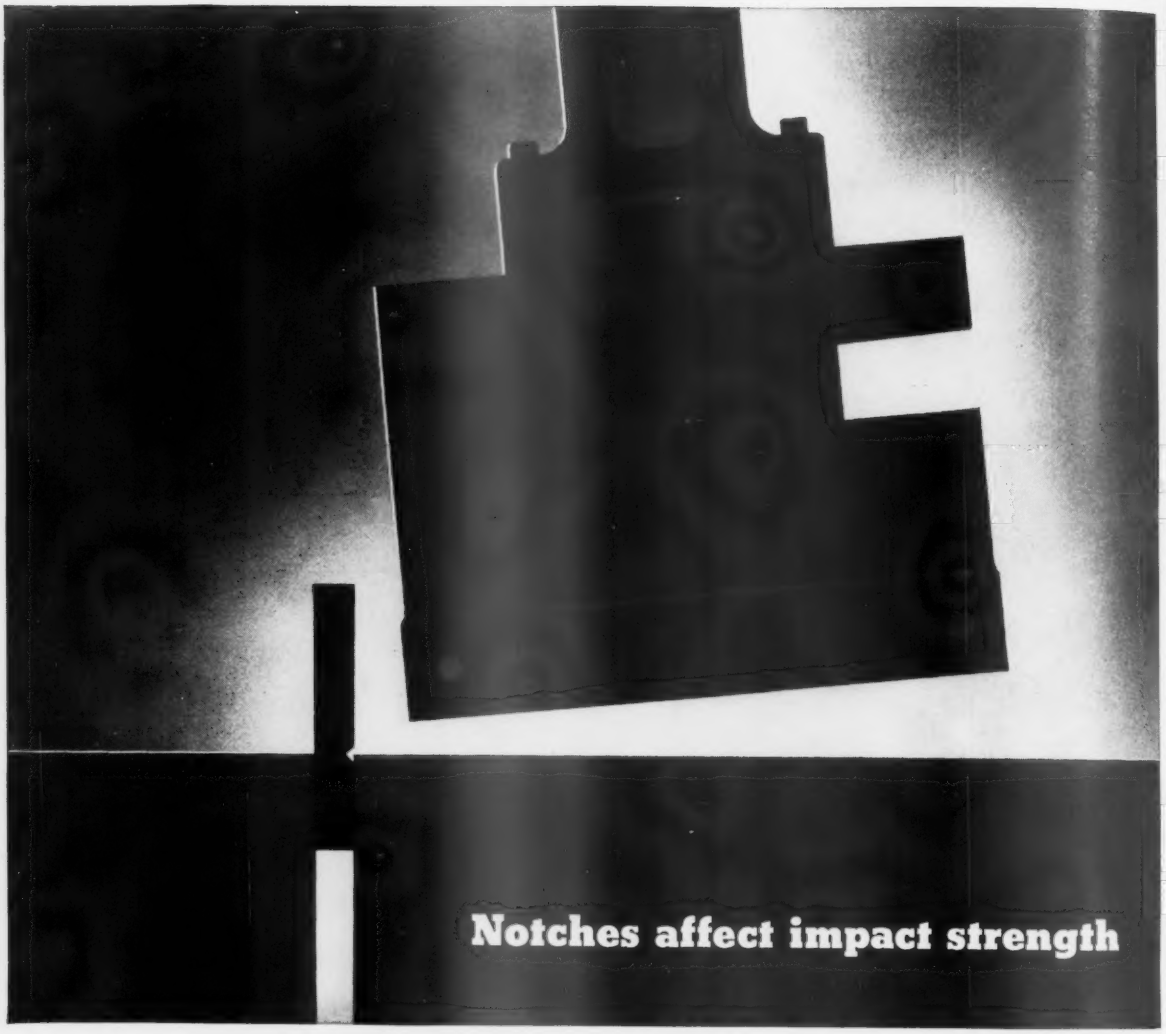

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The effect of fillet radius on the life of machine parts operating under alternating stress has been known for a long time. The knowledge has been put to good use in designing parts so as to avoid fatigue failures.

The effect of variation in the notch radius of Izod impact bars has shown the way towards the elimination of impact failures in filleted parts.

Two sets of standard size impact bars were machined from one heat of steel, both with a 45° notch. In one set the notch radius was 0.01 inch and in the other 0.05 inch. After quenching, and in some cases tempering, the bars with 0.05 inch radius consistently showed about 140% improvement in impact strength.

The practical application of these results, which consisted of increasing the existing fillet radius, has eliminated impact failures in a part where the problem had become serious.

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dene chloride are included. The discussion also covers types, applications, and advantages of fillers.

Three tables are contained in the article: one listing synthetic resins and cellulose derivatives; another, the physical properties of plastics; and the third, specific gravities of materials. *Aviation*, April, 1943, pages 141–143, 403, 3 illus.

Aircraft Plywood and Its Finishing Requirements. Part III. Charles A. Carter. The third installment of an article on finishing requirements and finishes for the protection of aircraft plywood. The characteristics and specifications of No. 802 plywood sealer and No. 8605 synthetic plywood filler are given. *Commercial Aviation*, March, 1943, pages 96–98, 4 illus.

Development of a Cast Resin Stretch Press Die. L. J. Jaworski. The development, construction, applications, and advantages of a plastic die for stretch presses, developed by the Fairchild Aircraft Division, are surveyed. It is claimed that a die, approximately 4 ft. across and 2 ft. thick, can be produced in one-third the time and at one-half the cost of former methods. The plastic die is formed of a Durez phenolic casting resin in a plaster cast. Its core is made of an inexpensive material that becomes an integral part of the die because of the bonding qualities of the casting resin employed. To demonstrate further the extent to which casting resins can be used, the article considers their application with regard to a few typical hydropress forming dies. *Aero Digest*, April, 1943, pages 230, 235, 5 illus.

The Development of Plastics. Raymond Cherry. The history of developments in the field of plastics is outlined. Plastics are classified according to their physical properties as thermoplastic and thermosetting. Plastics classified according to their chemical sources fall into four main groups: cellulose plastics, synthetic resin plastics, protein plastics, and natural resins. Manufacturing processes employed with the different types of plastics are described. The writer explains the use the aircraft industry is making of plastics and reviews the many types of aircraft parts that are now being made of plastics. *The Draftsman*, April, 1943, pages 28, 29, 45, 2 illus.

Laminated Plastics. A British method of manufacturing laminated plastic material from paper and fabric is outlined. The description of the process starts at the impregnating machine and follows through to the curing period. The use of cresylic and phenol resins is featured.

Typical articles manufactured from "Shellerite" thermoplastic, obtained from the redwood tree. (*See* page 163.)

The article also quotes a German commentary on the novel construction of the Spitfire seat, which is made of molded laminated plastic. However, since the particular techniques involved in manufacturing these seats cannot be disclosed, it is pointed out that the described procedure is a general one and does not apply to the Spitfire seats. *Flight*, March 18, 1943, pages 291, 292, 4 illus.

Transfer Molding of Phenolic Material. C. A. Norris. Highlights in the development of the transfer method of molding thermosetting materials are reviewed. The writer calls attention to the rapid evolution of plastic molding techniques during recent years and compares methods used in the past with present-day practice. The first transfer molding job is described and illustrated. Pressure-chamber design is discussed and an investigation of transfer molding possibilities made with the use of experimental molds is outlined. The molding of shock-resistant materials and mineral-filled materials is also described. Parts illustrated include three different types of shielded spark-plug connector elbows. *Modern Plastics*, April, 1943, pages 73–78, 20 illus.

High-Density Plywood. Malcolm Finlayson. The writer compares the physical properties of high-density plywood produced from Tego-bonded birch veneer (the grain direction of all plies parallel) with the corresponding properties of various metals. He shows that the strength properties are directly related to the specific gravity and finds that stress-strain curves in tension indicate that this material not only has no normal yield point but actually shows a decrease in elongation per unit load at high loads. The moduli of elasticity in tension and compression are shown to be greatly different. Other factors discussed are the behavior in torsion, the effect on the tensile strength of cross-lying veneers, the effect of immersion in water, and the effect of various humidity conditions. *Transactions of the A.S.M.E.*, April, 1943, pages 193–199, 10 illus.

Design Considerations for Plywood Structures. Part IV. L. J. Marhoefer. The fourth in a series of articles on the basic factors in the design of plywood aircraft structures is devoted to a discussion of innovations in wing design and to economies of materials and labor through simplification.

Early methods of making molded wing structures are reviewed and compared with simplified methods that have been developed. It is shown that all parts of a wing shell are subject to rational design with the exception of the required bending strength and rigidity of the skin about its span axis. A least-work computation for this is evolved. The mathematical treatment is given for the evaluation of the shear forces, as well as a method for the computation of the bending moments in the shell.

Results of tests applied to wings of the type covered are summarized, and it is concluded that simplified construction is feasible and worth the effort required to achieve it. *Aviation*, April, 1943, pages 164, 165, 167, 360, 363, 364, 10 illus.

Heating Wood with Radio-Frequency Power. J. P. Taylor. The use of radio-frequency power to provide heat for various types of wood processing such as seasoning, drying, curing of impregnating materials, gluing, and bonding is discussed. It is explained that the method is of importance in the production of plastic plywood planes, boats, and housings of various types. Subjects covered in the paper include the theory of radio-frequency heating and factors that determine its applicability and usefulness. Methods for the calculation of power required, time cycle, and operating cost are outlined. The means of handling some specific problems are reviewed and several typical installations are briefly described. *Transactions of the A.S.M.E.*, April, 1943, pages 201–212, 25 illus.

Mechanical Properties of Plastics at Normal and Subnormal Temperatures. T. P. Oberg, R. T. Schwartz, and D. A. Shinn. It is shown that balanced tensile, compressive, and shear properties are necessary in high-strength plastic materials developed for possible application in primary aircraft structures. Shear strength and shear rigidity also are important. The investigation, taken from Air

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Stout resistance to heat and corrosion are two important reasons why ARMCO Aluminized Steel is being used for firewalls in many of the new fighting planes. Tested and approved for this task, it is now undergoing tests in air-intake filters and other parts.

ARMCO Aluminized, a new specialty product of ARMCO's Research Laboratories is an *aluminum-coated steel*. It has the strength of steel and the surface-advantages of aluminum.

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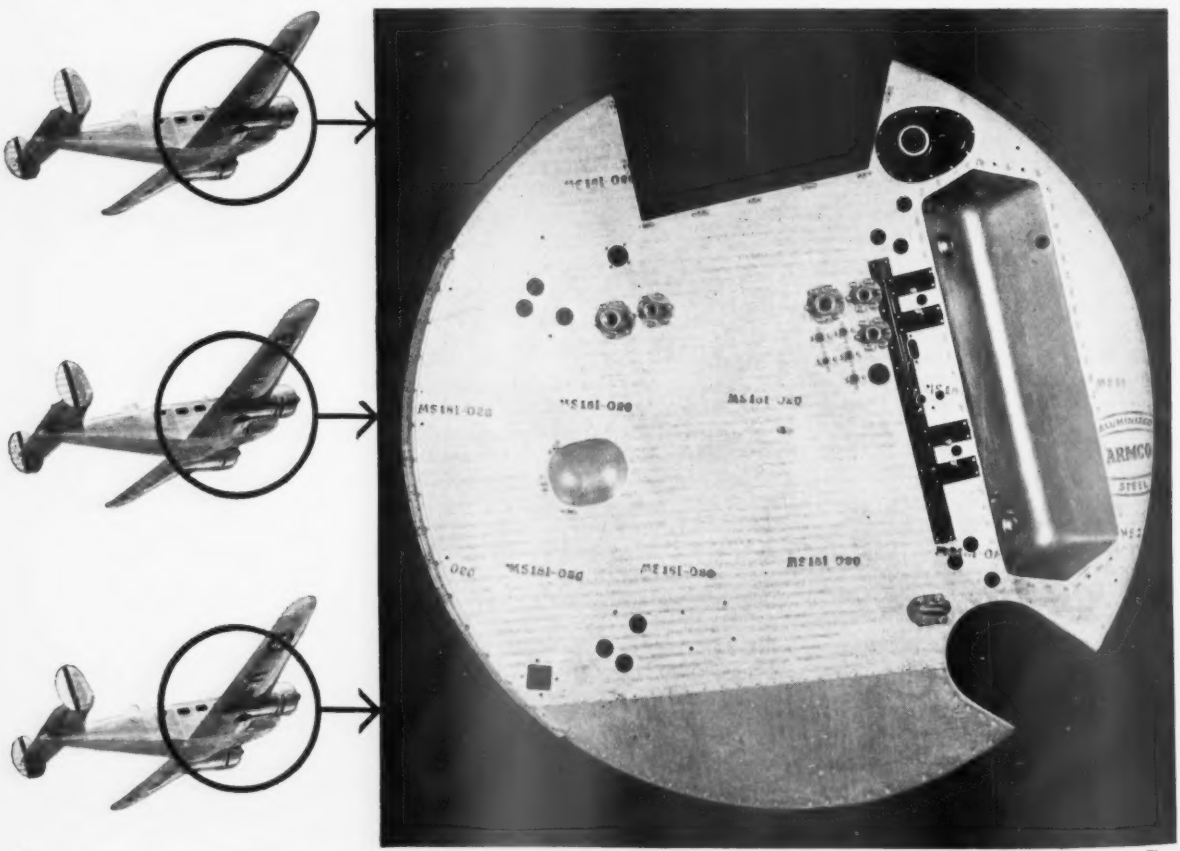

Beech Aircraft Corporation Photo

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Corps Technical Report No. 4648, is concerned with the determination of the static tensile, compressive, stiffness, and bending properties and the fatigue characteristics of a number of thermoplastic and thermosetting materials at temperatures of −38°, 0°, and 78°F.

The mechanical properties of the materials are tabulated and stress-strain curves are reproduced with special reference to their use in design. It is recognized that developments are constantly in progress in the plastics field, but the writers express the belief that the data given indicate the general trend for each specific type of plastic. *Modern Plastics*, April, 1943, pages 87–100, 122, 124, 126, 128, 17 illus.

Postwar Aviation

Industry in the Postwar World. Arthur W. S. Herrington. Future avenues of production which will be opened by the research of today are described. The writer points out that research is pushing the frontiers of industrial opportunity outward at a rate that could not possibly be conceived two years ago. The part electronics has played in the development of a means of locating enemy air- and water-borne military units is described. Remarks are made on advances in the chemistry of the hydrocarbons.

The development of new fuels that have a high energy content and will not burn in the open is discussed. Developments in the field of air transport and improvements in aircraft brought about by the expanding knowledge of aerodynamics are outlined. The future possibilities of air cargo transport are considered. *Army Ordnance*, May-June, 1943, pages 496–498.

The Skyways of Today are the Highways of Tomorrow. William A. Hunter. Canada's postwar destiny in the matter of air transport is considered. It is noted that the subject cannot be discussed from a purely national angle, since postwar air transportation is an international and political matter that is now engaging the attention of all nations. Historic developments in international air transport are reviewed. How mail contracts helped to create and foster air lines in Europe, the United States, and Canada is described. The introduction and growth of express routes is outlined. It is shown that the first large-scale attempt to establish air transport in Canada was brought about by the discovery of oil at Fort Norman late in 1921. The writer discusses the formation of Canada's air lines and considers aerial transport requirements of tomorrow. The views of Great Britain and the United States on air transport problems of the future are studied. *Commercial Aviation*, March, 1943, pages 22–26, 28, 30, 32, 34, 37, 33 illus.

Postwar Preview of European Airways. Maurice A. Garbell. The writer suggests an airways system for Europe which is designed to facilitate rehabilitation of the continent following the collapse of the Axis in Europe, speed termination of the war in the Pacific, and extend its operations at the time when the entire war is ended. An accompanying map illustrates the routes of the outlined network and its primary focal points. Six main arteries for air traffic are proposed as a nucleus for the European airways system: (1) the Northern Atlantic artery, entering the European continent through Ireland, England, and Norway; (2) the Arctic artery for connecting the American west coast directly with Eastern Russia and Southern Asia; (3) the Siberian artery connecting Europe with the Far Eastern Pacific coast; (4) the Near-East and India artery, constituting a life line for United Nations forces in the Indian area; (5) the African artery, connecting Europe with East and South Africa; (6) the Southern Atlantic artery, connecting Europe with the North and Central American countries and islands via the Azores and with the South American continent via the Dakar-Natal airway.

Four directions in which the Northern Atlantic artery should logically branch out are also designated, and five main routes that the east-southwesterly flow of air traffic across Europe should follow. *Aviation*, April, 1943, pages 202, 203, 337, 338, 2 illus.

World Partnership in the Air. William S. Hill. Indicating the strong ties between aviation and world peace, a United States Congressman comments upon several problems of international air commerce after the war. It is his opinion that reciprocal airway agreements offer a major basis for achieving "freedom of the air," with Portugal offered as an example that such agreements do work. He advocates an international air police power to enforce peace and patrol air bases, particularly in the Pacific. He suggests that steps be taken at once to make permanent acquisitions of all bases that figure in American hemispheric influence. However, those bases that have been developed by the United States in Europe, Africa, Asia, etc., he believes, should be available to all nations for legitimate commercial purposes. Other points he covers concern specified air lanes for foreign planes over each country's territory and the question of commercial air competition between Great Britain and the United States. *Flying*, May, 1943, pages 55, 158, 161, 1 illus.

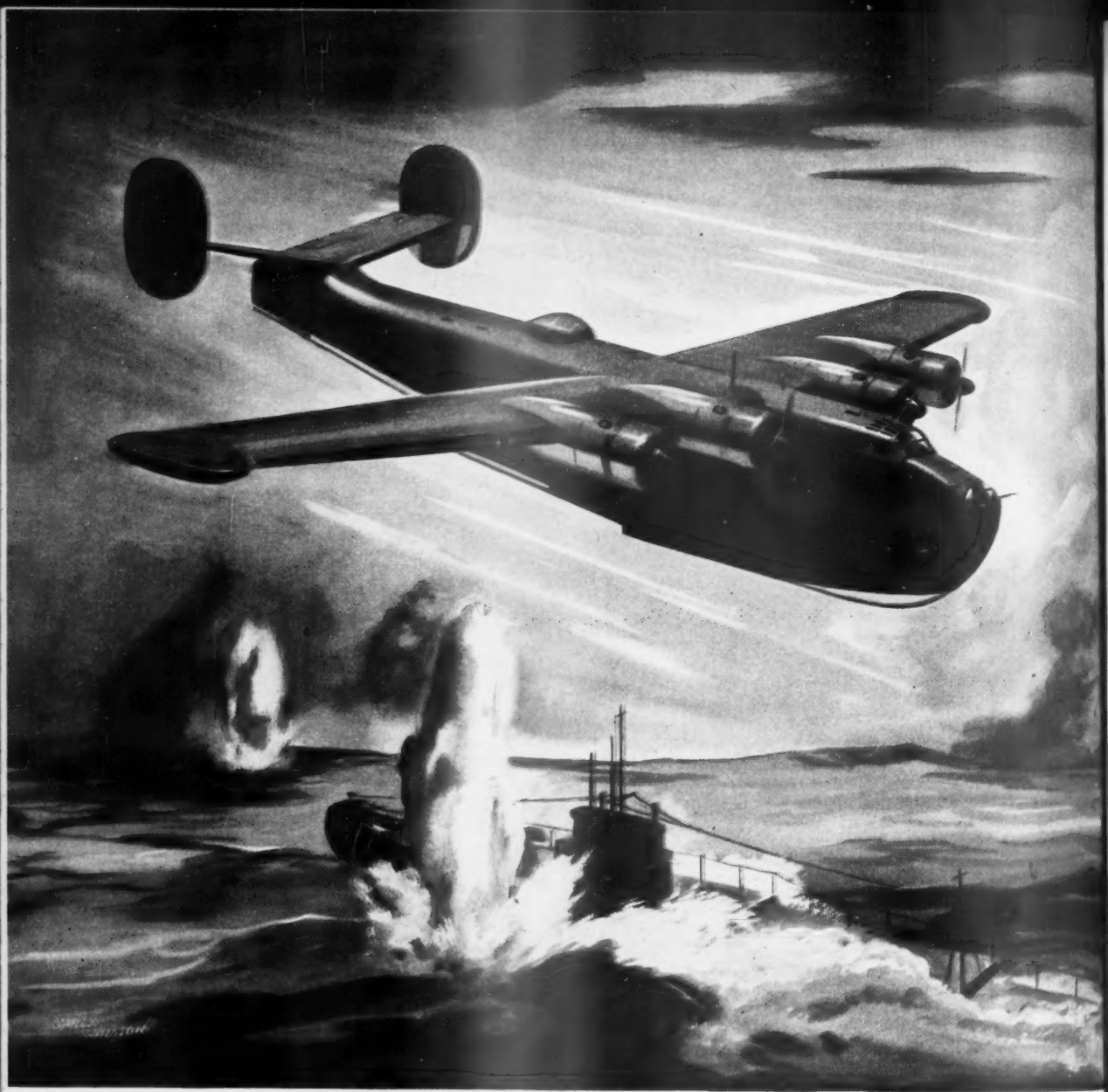
Post-War Aviation Plan Needed Now. Ralph S. Damon. Strongly urging the immediate formulation of constructive postwar plans for the aviation industry, the President of Republic Aviation Corporation stresses the value of discussion now and gives his reasons. He denounces past blunders of confused air policy, warns against repetition of "bureaucratic" hindrance, and asks for industry representation in international air policy planning.

In presenting his views on the future peacetime development of aviation, the writer gives an optimistic picture. His observations touch upon the potentialities of transport, cargo, and private flying. He also expresses the opinion that the automobile industry will not produce complete airplanes after the war but will limit its possible activity in the aeronautical field to the manufacture of engines and accessories. *Southern Flight*, April, 1943, pages 42–44, 46, 51, 6 illus.; **Peace Airways—Markets Unlimited,** Ralph S. Damon, *U.S. Air Services*, April, 1943, pages 16, 17.

Plan Now for Postwar Era of Cargo-by-Air. Lawrence B. Sizer. The writer pictures how business will be carried out in the postwar era when distances over the world will be shrunk by the operation of large cargo and passenger planes. It is indicated that revised distributing and marketing methods will be required in a world made small by advances in air transport. Basically important elements in the selling picture which will have to be changed to meet the new conditions are enumerated. Planning for postwar business is discussed. *Air Transportation*, April, 1943, pages 5–9, 2 illus.

Private Flying

Services Needling Amateur Flying Unnecessarily. Margaret Chase Smith. A discussion on the immediate fate of private flying and the effect of Army control on the Civil Air Patrol. Among the points covered by the writer are: the W.P.B. order freezing all sales of private planes, its possible application to rentals of planes to private students, the limitation of the nation's pilot reservoir and the employment of women as instructors in the Army and Navy primary flight courses. *Skyways*, May, 1943, pages 12, 13, 78, 80, 6 illus.



The navy patrol bomber takes its weather as it finds it . . . tropical heat, arctic cold, sudden temperature changes, sun, rain, snow, hail, wind. No other type of plane is subjected to more difficult operating conditions. And the more difficult the conditions, the surer you are to find that the finish is Berryloid.

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AIRCRAFT FINISHES

Production

Avro Lancaster. Part IV. Wilfred E. Goff. The concluding installment of a series of articles on the production of the Avro Lancaster covers the production of the undercarriage support beam and the final assembly of the complete aircraft. Molding and machining practice on the large magnesium-alloy casting by which the undercarriage legs are attached to the front spar of the center section is described. For the final assembly a line system is employed similar to that used for the fuselage. *Aircraft Production*, April, pages 159–165, 22 illus.

Birth of a Bomber. J. I. Waddington. The factory organization and production planning preparatory to a changeover in the manufacture of British aircraft types are outlined. Four divisions in the production breakdown of the design drawings are: (1) planning sheets—defining the operations necessary for the manufacture of details, subassemblies, and assemblies; (2) tool instruction sheets—issued for each tool or jig required for manufacture; (3) parts list—a schedule of the details and subassemblies required to produce a complete modification; (4) material schedules—a summary of all the quantities and specifications of all the needed raw materials.

The related procedures touch upon the functions of the following departments: material, production, planning, material control, scheduling, tooling, works order, rate fixing, and inspection. *Flying*, May, 1943, pages 36, 37, 164, 3 illus.

Single Assembly Line Produces Both Bombers and Transports. R. C. Sebold and S. J. Powell. The assembly line at Consolidated Aircraft Corporation's Texas plant is described in detail, showing how Liberator bombers and Liberator Express cargo transports are simultaneously turned out on the same line without decreasing the production rate. It is demonstrated how design and production ingenuity contributed toward making this flexibility of output possible. Since the changes necessitated by the bomber-to-transport conversion were comparatively minor ones of a structural or installational nature, it was found feasible to make them along the final assembly line. The great length of the Consolidated line also contributed to the efficiency of the plan, since it permitted a division of the changes and prevented the congestion caused by large numbers of employees working at one station and impeding each other's progress. In addition to noting the conversions required between the two types of planes, the article particularizes some of the problems involved in setting up the single assembly-line technique for both bombers and transports. *Aviation*, April, 1943, pages 126–133, 403, 404, 24 illus.

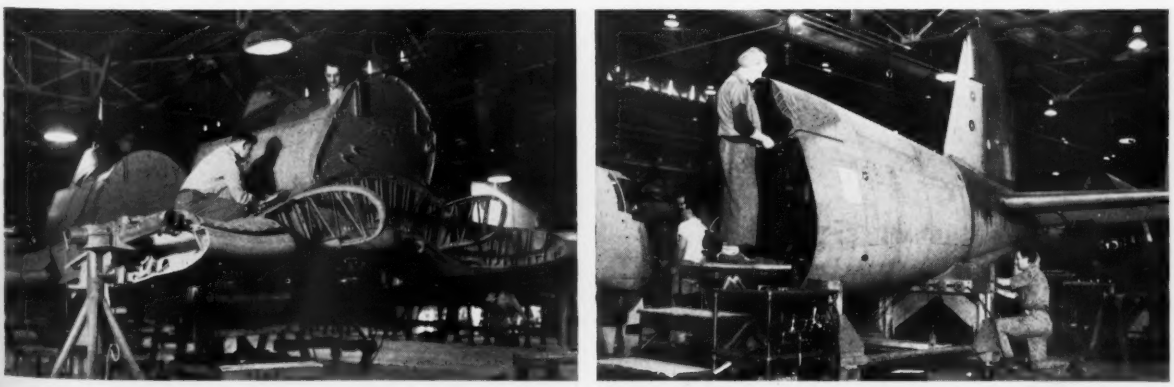
Technical Developments in High-Production Sheet Metal Forming. William Schroeder and Thomas H. Hazlett. Developments in the field of sheet metal forming are discussed at length. Phases of the subject receiving particular attention include the basic analysis of sheet metal forming operations, classification of parts into basically similar groups, forming techniques, and limits to which the commonest material may be successfully formed. The need for quantitative knowledge of the forming limits for die and aircraft design is emphasized. The common types of forming equipment, their applications and limitations, are discussed. Methods capable of high rates of production, such as the rubber pressure hydro-press and the double-acting press, are given particular attention. Forming limits and techniques for flanging, stretching, drawing, and redrawing are described. *S.A.E. Journal*, May, 1943, pages 170–192 (Transactions), 56 illus.

Quality Control. W. A. Bennett and J. W. Rodgers. A quality-control method for the inspection of small machine components manufactured in quantity is described. Problems connected with recording the results of multidimensional inspection are discussed. An illustration is given of an inspection record that provides a quick means of reference as to the trend of quality in a machine shop. A control chart shows the improved quality of the work resulting from the introduction of the record card. *Aircraft Production*, April, 1943, pages 172–175, 5 illus.

Aircraft Engines for the Mosquito Built on Conveyor Line. Franklin M. Reck. The introduction and use of the conveyer line to speed the production of Rolls-Royce Merlin engines at the plant of the Packard Motor Car Company is described. The writer tells how Packard, faced with the prospect of capacity business in engine manufacture, quickly put its manufacturing and assemblying operations on a conveyer basis. Important features of the system are described and illustrated. *Commercial Aviation*, March, 1943, pages 76–79, 7 illus.

Globe Aircraft in Production. R. T. Gidley. The writer tells how Globe Aircraft organized its production system to utilize existing small shops and manufacturing facilities outside of its own plant for producing twin-engined AT-10 Trainers. He gives some of the problems that emerged with the institution of the subcontracting pool, as well as the solutions found for them. Component parts and materials of the AT-10 are listed. *Southern Flight*, April, 1943, pages 34, 35, 38, 39, 17 illus.

Photography and Production. A. Batley and F. W. Coppin. Techniques



Employees work (*left*) on the center section of the F4U1 Corsair and (*right*) on the aft portion of the plane. When completed these sections are bolted together.

TO HIT 'EM H-A-R-D-E-R

THE year 1943 promises to be the grimmest, hardest year this country has ever faced. Every effort, and every dollar of national income not absolutely needed for existence, should go into war work and War Bonds.

In the Pay Roll Savings Plan, America finds a potent weapon for the winning of the war—and one of the soundest guarantees of the preservation of the American way of life!

Today about 30,000,000 wage earners, in 175,000 plants, are buying War Bonds at the rate of nearly half a billion dollars a month. *Great as this sum is, it is not enough!* For the more dollars made available now, the fewer the lives laid down on the bloody roads to Berlin and Tokio!

You've undoubtedly got a Pay Roll Savings Plan in your own plant. But how long is it since you last checked up on its progress? *If it now shows only about 10% of the gross payroll going into War Bonds, it needs jacking up!*

This is a *continuing* effort—and it needs *continual* attention and *continual* stimulation to get fullest results.

You can well afford to give this matter your close personal attention! The actual case histories of thousands of plants prove that the successful working out of a Pay Roll Savings Plan gives labor and management a common interest that almost inevitably results in better mutual understanding and better labor relations.

Minor misunderstandings and wage disputes become fewer. Production usually increases, and company spirit soars. And it goes without saying that workers with substantial savings are usually far more satisfied and more dependable.

And one thing more, these War Bonds are not only going to help win the war, they are also going to do much to close the dangerous inflationary gap, and help prevent post-war depression. The time and effort *you* now put in in selling War Bonds and teaching your workers to save, rather than to spend, will be richly repaid many times over—now and when the war is won.

You've done your bit Now do your best!

This space is a contribution to the victory today and sound business tomorrow by
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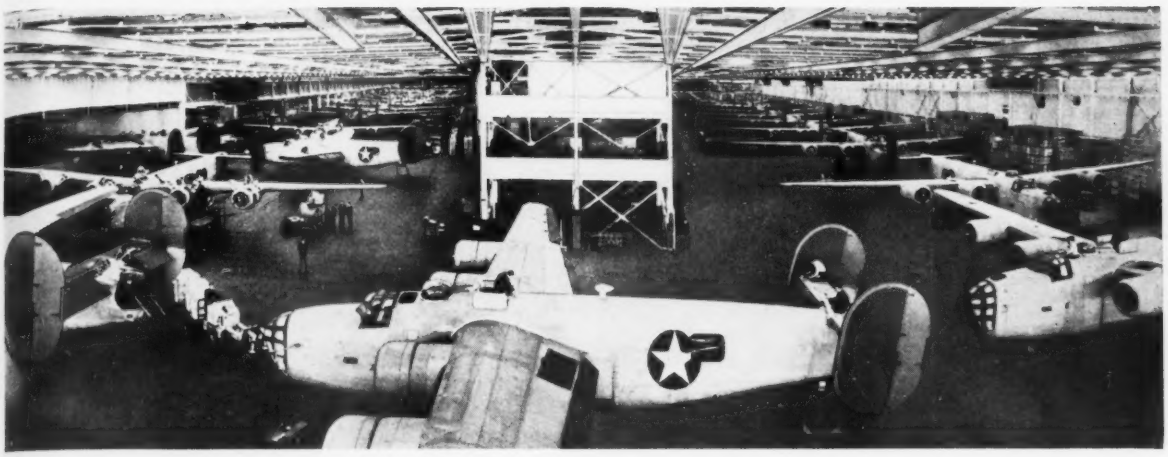


Liberator bombers on the twin assembly lines at the Willow Run plant of the Ford Motor Company.

and equipment used in the photographic method of making precision-scale reproductions of drawings, templates, and jigs are presented. The equipment used by Handley Page, Ltd., is credited as having been the first firm in England to install large-scale equipment for the photographic reproduction of loft layouts. The article includes a description of a special technique known as "reflex transfer," which is applicable wherever the copy must be of the same size as the original and where a white line on a black ground is acceptable. *Aircraft Production*, April, 1943, pages 190–194, 7 illus.

Modification Centers . . . An American Military Innovation. Glenn Hotchkiss. How United States airplanes are weatherized and otherwise equipped for specific theaters of operation or special missions is told in this article. The procedures described are those followed at the modification center of the Consolidated Aircraft Corporation, Tucson, Ariz. In addition to noting assembly line and fabrication methods, the writer considers the problem of personnel at the modification centers. He also shows the correlation of work between the modification centers and the parent plants. Although depicting the work of the center as an extension of that carried on at the plant, they indicate why the very nature of the former requires even greater fluidity of methods, equipment, and line arrangement.

The article's introduction includes an explanation of what a modification center is. *Aviation*, April, 1943, pages 134–136, 329, 330, 333, 9 illus.; "Modified Air Superiority," Tony Hagmann, *Southern Flight*, April, 1943, pages 48, 49, 2 illus.

'Will It Run?' Robert Stewart. The writer estimates the number of airplanes the Ford Motor Company's Willow Run plant will be able to turn out and analyzes the problems that have hindered Willow Run from achieving its maximum efficiency. He refutes the overoptimistic reports of "1,000 planes a day" but states that the laudable record of "a bomber an hour" will be reached.

The failure of the start of bomber production at Willow Run to meet the forecasts of Ford executives is attributed mainly to the following four reasons: (1) Because Willow Run most nearly represents the automotive industry's conception of quantity production, it is more elaborately tooled than most factories and represents a tremendous investment in make-ready time. (2) As a subcontractor to Consolidated Vultee Aircraft Corporation, Willow Run had to obtain Consolidated's approval of hundreds of minor design changes necessitated by Ford's innovations in production technique. (3) Innumerable design changes had to be put through on the Consolidated Liberator when the B-24 was adapted also for use as a cargo and transport plane. (4) Difficulties in obtaining and keeping sufficient man power for the plant.

The main points of discussion with regard to the man-power problem cover the questions of: transportation, housing, taxation, hiring of employees, and morale. *Flying*, May, 1943, pages 21–23, 150, 154, 5 illus.; "Willow Run—Today," Franklin M. Reck, *Aero Digest*, April, 1943, pages 112–115, 243, 244, 256, 13 illus.

Design of Sand Castings for Quantity Production. Part 1. N. F. Hindle. This is the first of a series of articles on the design of sand castings and gives some detailed but generally applicable design rules peculiar to sand castings in both ferrous and nonferrous materials. Sections of this installment discuss the production of sand castings, advantages of the sand-casting process, how sand castings are made, match-plates used to produce castings in large quantities, melting, pouring, finishing, and the selection of casting materials. *Metals and Alloys*, April, 1943, pages 770–775, 7 illus.

Consolidated Subcontract System Coordinates Schedules. Howard G. Golem. The Consolidated Aircraft Corporation's system for coordinating schedules between subcontractors and the home plant is given in detail. In addition, a portion of the article is devoted to a consideration of the possibilities in the company's feeder shop operation. Problems of correlating out-plant manufacturing, accelerating and decelerating the work, are discussed. Methods of charting, letting contracts, and aiding the subcontractor are noted and information is given about the organization and duties of Consolidated's subcontract production department. The writer also lists the larger components of the Liberator which are subcontracted.

In explaining the "feeder shop" system of establishing small shops operated by Consolidated under company foremen, limitations of the plan are marked. It is stated that because machinery is not available and special types of buildings cannot be found at present the jobs at these shops must be nonmachine work, such as upholstering, electrical harness, tube bending, and relatively nonmechanized work. *Aviation*, April, 1943, pages 195, 197, 342, 345, 346, 349, 350, 4 illus.

The Soviet Aircraft Industry. M. Ter-Arutyunyants. How the Soviet Union's aircraft industry is coping with war tasks is described. Improvements that have been realized since the All-Union competition for aid to the front was launched in May, 1942, are related. It is explained that the achievements of the aircraft industry have been insured by fostering initiative on the part of the workers which

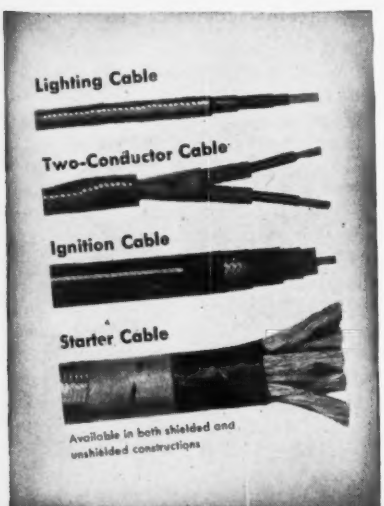
IT'S WIRY JOE FOR AVIATION WIRE and CABLE

There was a time that Wiry Joe was merely the largest independent manufacturer of replacement wiring for the automotive industry.

Now, Wiry Joe is also known as an important source of supply for every type of electrical wire and cable for aircraft. The complete line includes starter cable, high-tension cable, primary cable, both original and replacement. Wiry Joe also makes power and welding cable.

And just as Wiry Joe automotive cable won a name for quality, so, too, has Wiry Joe aviation cable. Every item in the line is built to meet rigid Army and Navy specifications, and is produced under the Dostam method of manufacture for uniformity, dependability, high efficiency and long life.

Inquiries regarding wire and cable for any type of service will be answered promptly.



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has resulted in an advance in the rationalization of production methods. Production problems that were solved by the cooperative efforts of engineers and workers are described. The writer tells how rhythmic work all along the production cycle has contributed to the overall fulfillment of government orders by the industry as a whole. *Indian Aviation*, December, 1942, pages 298, 299.

Gliders from the Wolverine State. Details are given on the production processes and materials used in constructing gliders at the plants of the Ford Motor Company and of a group of Michigan furniture manufacturers. The Ford plant at Iron Mountain is described, with reference to the equipment, materials, and methods employed, and information on the facilities of the 15 companies that comprise the pool known as Grand Rapids Industries, Inc., is given. *Modern Plastics*, April, 1943, pages 62–66, 128, 13 illus.; "The Furniture City Joins the Air War," *Aero Digest*, April, 1943, pages 145–148, 153, 154, 156, 157, 14 illus.

New Tube Spinning Process. A process that enables metal tubes to be spun into closed or partially closed ends, which has been developed by the Wolverine Tube Division of the Calumet and Hecla Consolidated Copper Company, is described. The process combines reducing, necking, closing, fabricating, and wall thickening. Features of the process are outlined. The method embodies hot-forming by spinning to a predetermined shape without the application of external heat. The process accomplishes a controlled plastic deformation as a result of the special design of the spinning tool.

It is stated that copper and practically all of its alloys have been successfully formed and also most of the aluminum alloys, both common and high strength. Heat-treatable aluminum alloys can be formed without special annealing. Present indications are that there may be limitations restricting the handling of some of the steels, although various jobs have already been accomplished with ferrous materials. *Heat Treating and Forging*, April, 1943, pages 191, 202, 203, 1 illus.

Propellers

Design and Manufacture of Curtiss Propellers. Features of the Curtiss electric controllable-pitch propeller are discussed. Reasons for full feathering are given and the advantages of this type of propeller are explained. The article includes mention of design problems, materials used for the con-

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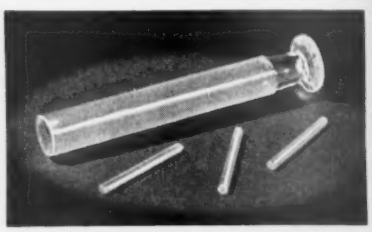
Precious blood plasma for the wounded, serums for the sick, narcotics to deaden pain—yes, hypodermic injections are vital life-savers on every battle front!

Today, the plungers for these hypodermic injectors are made of glass, centerless ground within a tolerance of .0005" for roundness and dimension. The accuracy and finish of the centerless grinding is of



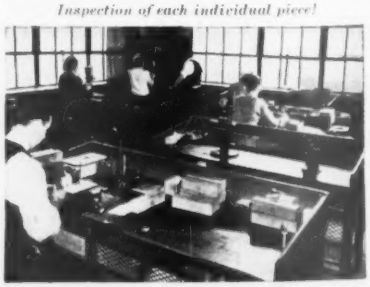
Lives depend upon the accurate grinding of these little pieces of glass.

the utmost importance. Any pitting or irregularity may permit air bubbles to get into the fluid and, in turn, be pumped into the blood stream with fatal results.

Accurately ground glass plays another important part in the war effort, too. Glass "go, no-go" plug-type gauges ground within a tolerance of .0001" are helping manufacturers of vital precision parts for planes, tanks, guns and ships do a faster, better job.

Precision grinding of every type with amazing accuracy, ON A MASS PRODUCTION BASIS!—that's ACE's vital contribution to winning this war. Here is a great American plant with precision tools, centralized responsibility and sleepless ingenuity. Here is where to come for practically every operation in the manufacture of small parts where accuracy is required, both now and after the war.

Inspection of each individual piece!



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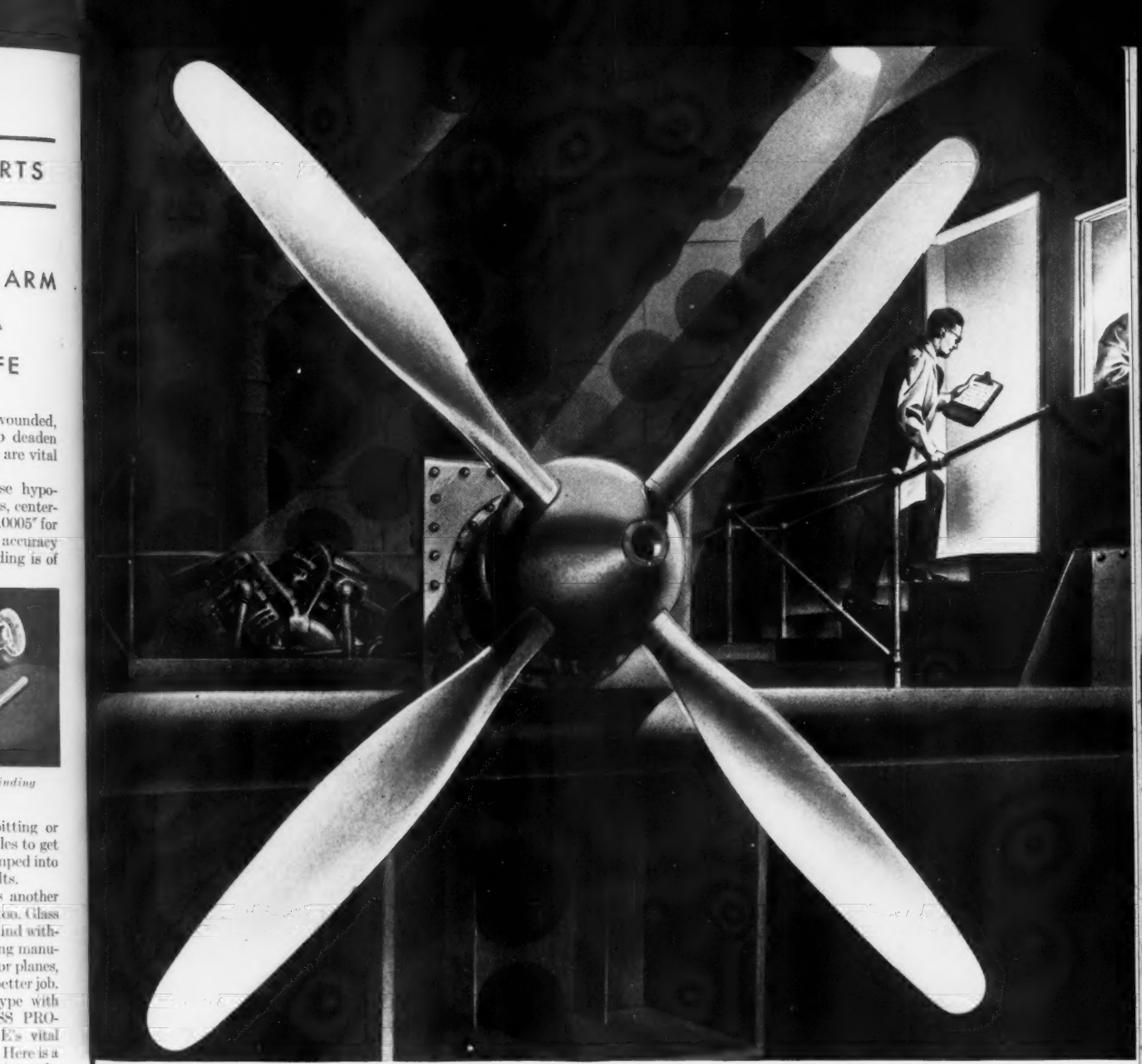

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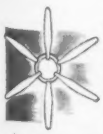
LIGHT—Weight is at a minimum in the Aeroprop, with its ribbed steel blades.

STRONG—Propellers on combat planes take a terrific beating. The Aeroprop is engineered to "Keep 'Em Flying."



SIMPLIFIED—Aeroprops are built as a self-contained unit. Automatic pitch control and power mechanism for pitch changes are integral parts of the compact propeller assembly.

IN a matter of seconds these four broad blades will be a whirling blur of steel. For hours this production propeller will roar through paces that are tougher than actual combat conditions. Engineers will watch it constantly. A battery of instruments will measure and record every performance factor throughout the run.

After passing all tests it's a true Aeroprop, ready to wear that name proudly in the service of our nation.

Graduates of this test house are chalking up performance records daily on the fighting fronts. Their strength—their lightness—their rapidity and precision of pitch control—their compact unit-construction, simplifying installation and shortening service operations—these are Aeroprop principles that pay off in successful missions, both in war and peace.

AEROPROP

AEROPRODUCTS DIVISION **GENERAL MOTORS** CORPORATION

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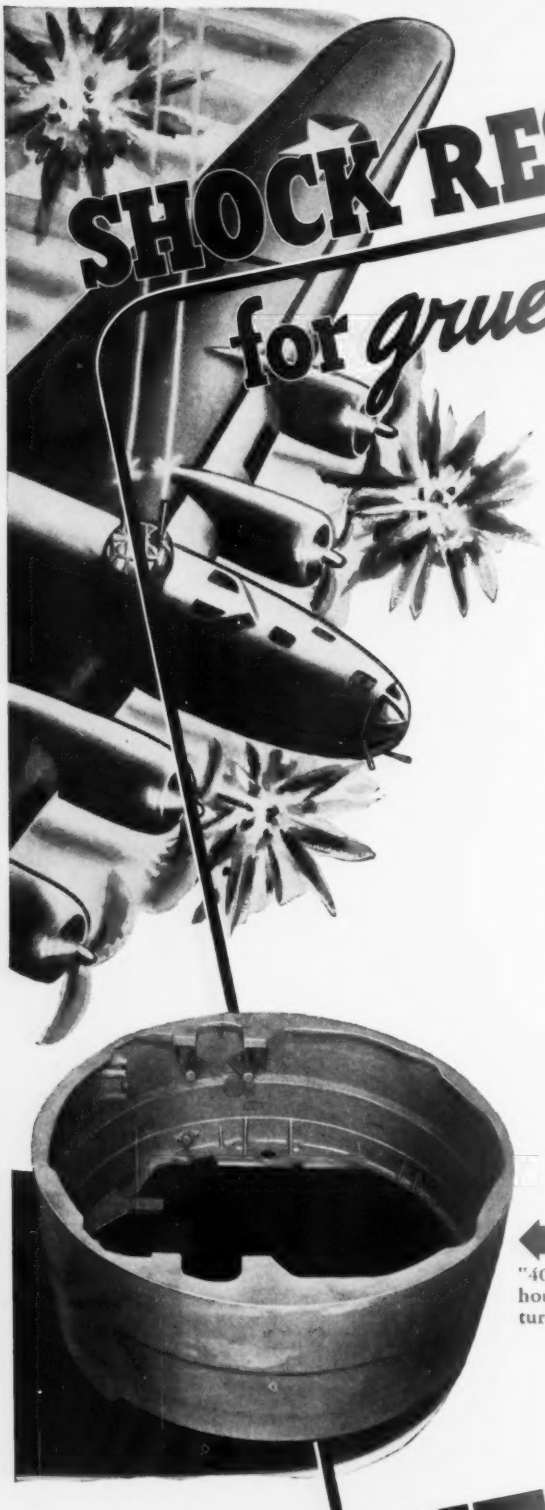
BUY WAR BONDS — KEEP AMERICA FREE!

SHOCK RESISTANCE for *gruelling* workouts!



The exclusive use of Frontier "40-E" Alloy for the unit housings of the top gun turrets of Flying Fortresses is a significant tribute to the unusual physical properties of this new member of the aluminum alloy family.

Frontier "40-E" has exceptional ability to withstand shock—the shock of explosive impact. Not only does it resist rupture to a high degree, but also deformation which leads to misalignment and consequent uselessness of the affected part.

Outstanding features—the result of a unique combination of "40-E's" high yield and tensile strengths and its elongation, attained through natural aging, is rapidly winning for "40-E" a prominent place in the production of castings for modern warcraft.

Several foundries from coast to coast are now "40-E" licensees. Increased demand for "40-E" castings has required an increased production of this new alloy and demands the licensing of additional foundries now engaged in war production. Your request for complete licensing data will receive prompt attention.

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NIAGARA FALLS, NEW YORK

Casting of Frontier "40-E" Alloy for housing of gun turret.

Handy Alloy Data Book, containing important metallurgical and engineering information just off the press. Write for your free copy, stating your name, title and address.

FRONTIER "40-E" *Alloy*

struction of the propeller, and manufacturing processes.

Two new Curtiss-Wright developments are also described. One is an automatic speed synchronizer designed to eliminate the necessity for making periodic adjustments of constant-speed propeller controls. The other is a six-blade, dual-rotation propeller built around the principle of electric control of the blades. This propeller is designed primarily for high-altitude airplanes with 2,000-hp. engines. A constant-speed governor controls its operations automatically but it may also be operated manually by a switch. *Aero Digest*, April, 1943, pages 179, 180, 272, 275, 276, 5 illus.; "A New Twist in Props," Doris N. Ahnstrom, *Skyways*, May, 1943, pages 30, 31, 66, 6 illus.

Wood Airscrew Blades. The advantages of wooden blades, as used with Rotol propellers of various types, are described. Only brief reference is made to the manufacturing process. The propeller embodies a hollow steel root adapter capable of holding the base of the blade in a compressed condition and so providing the degree of support necessary to meet stresses imposed in flight. The types of wood blade coverings are itemized. Weight comparisons are made between duralumin and wood airscrews for various aircraft types. The physical properties of wood blades are listed. *Aircraft Production*, April, 1943, pages 155–158, 7 illus.

Dynamic Balancing in Propeller Maintenance. B. J. Cumnock. Explanation of a method for obtaining perfect dynamic balance of propellers during engine overhaul. This is based on a diagram and plotting system for determining the number and location of lead discs to be added in the hollow balancing bolts of the propeller hub. It is claimed that this method eliminates guesswork, saves time, and is successful 90 per cent of the time on the first attempt. *Aviation*, April, 1943, pages 214, 403, 2 illus.

Rotating Wing Aircraft

Aviation's Rope Trick. Comments on helicopter flight are described by the writer as some random thoughts. It is stated that the favorable factors that the helicopter presents are essential to the ultimate utility of flight. The advantages of the helicopter are discussed and its future effects on private and commercial flying are considered. It is suggested that the principles of the helicopter might be used to help ease large aircraft down to their landings without the shocks that now necessitate ultraheavy landing gear and brakes. *National Aeronautics*, April, 1943, pages 16, 46, 4 illus.

Rotating-Wing Aircraft. This is the first in a series of articles on the development of rotating wing aircraft and is concerned mainly with the trend of progress in gyroplanes. It is related how experimental work with autogiros established certain fundamental facts putting the theory of rotating wings on a sound basis. The development of a series of autogiros by Senor Juan de la Cierva is described and explanations are given of their operating principles. Early helicopter inventors and manufacturers of planes incorporating the Cierva system are mentioned.

In detailing the problems of gyroplane development, the article designates those of stability and control as being the most difficult. *Flight*, March 25, 1943, pages 305–309, 14 illus.

Stress Analysis

Bending Strength in the Plastic Range. Frank P. Cozzone. The conventional linear distribution of stress in a section subjected to bending in the plastic range, as usually represented by the classical my/I formula, has been replaced by a simple trapezoidal distribution that varies with the applied bending moment. This latter distribution approximates the distribution based on the actual stress-strain characteristics of the material and the shape of the cross section.

A method has been developed for use throughout the elastic and plastic range of bending which covers the following points: (1) the resisting moment of any cross section corresponding to any extreme fiber stress up to the ultimate stress of the material; (2) the corresponding stress distribution over the entire cross section; (3) the corresponding shear distribution; (4) the effects of local crippling; (5) complex bending; and (6) the combined effects of axial load and bending. *Journal of the Aeronautical Sciences*, May, 1943, pages 137–151, 19 illus.

Determination of the Buckling Load of Struts with Successive Approximations. J. Ratzersdorfer. The writer explains the application of a method of successive approximations to the determination of the buckling load of struts with hinged or built-in ends. The method is useful where the exact determination of the buckling load is a complicated problem. It is stated that the method is also applicable to the solution of the differential equation that results when the loads are continuously distributed along the length of the strut. *The Journal of The Royal Aeronautical Society*, March, 1943, pages 103–105, 1 illus.

Testing

Flight Testing is a Sound Business. Edmund T. Allen. In this first of three posthumously published articles on the science of flight testing, the writer explains the essential purposes of a flight testing unit and describes how the Flight and Aerodynamics Department of the Boeing Aircraft Company functions. Accompanied by an illustrative chart, the departmental organization of this vital Boeing division is outlined. It is reported that in the performance of its dual functions—flight testing and aerodynamics—the autonomy of the Flight and Aerodynamics Division is equal to that of the Engineering, Manufacturing, and other divisions.

The writer lists the purposes of flight testing as covering two kinds of testing: one, the testing of a new model for performance and operational guarantees; the other, development testing to obtain design information corroborating (a) mockups, (b) simulated laboratory tests, (c) theoretic studies, and (d) model tests. *Aviation*, April, 1943, pages 109–112, 4 illus.

This Plexiglas bomber nose was converted by R.C.A. engineers into a high-altitude test chamber for aircraft and electronic equipment. (*See* page 161.)

Proving Ground for Victory. Illustrations are accompanied by a brief description of activities at Wright Field. Before the war, Wright Field engineers were concerned primarily with testing and improving existing aircraft. The changes that were brought about when this testing field was made an Army base are outlined. Planes, personnel, and equipment are now being tested for the United Nations. *Air News*, April, 1943, pages 38, 39, 54, 6 illus.

Looking Around. "Witness." This begins a series of notes from a test pilot's diary, dealing with the problems that arise during the testing of production aircraft. Part one is devoted mainly to stressing the importance of careful inspection by the pilot before a plane is taken up for its first flight.

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It is shown how, in addition to the safety factors involved, economies can be achieved by the pilot's ground checking. *Flight*, March 18, 1943, page 288.

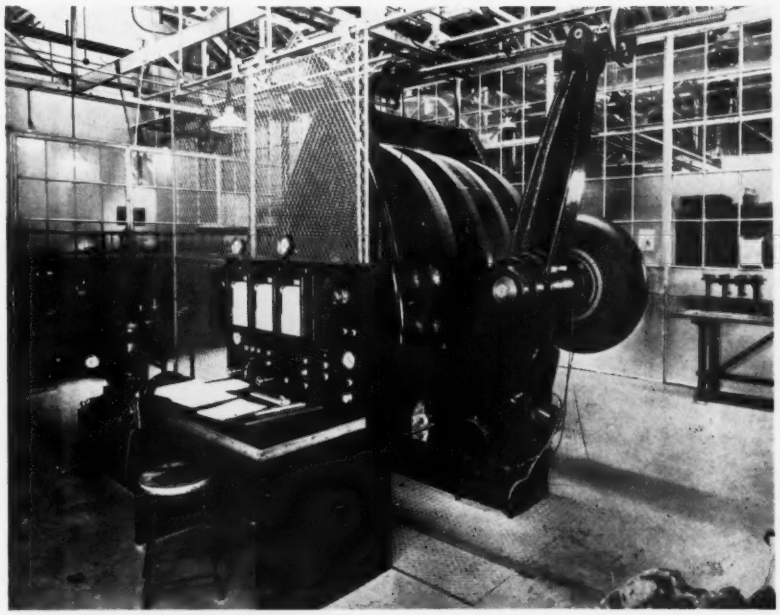
Warming Up. "Witness." A continuation of the notes from a test pilot's diary. This second article deals with correct procedures for warming up the engine preparatory to a test flight. In it the writer emphasizes the desirability of bringing the engine up to operating temperature as quickly as possible and discusses the importance of oil dilution. He also advises on the judicious use of hot-air intake and gills. *Flight*, March 25, 1943, page 311.

Tools and Equipment

Progressive Dies Play an Important Part in War. C. W. Hinman. The important part that modern types of progressive dies and punches are playing in the war industrial program is emphasized. The designing of progressive dies and punches is described. It is explained the first step is to make a careful study of the proposed part to be produced. Further steps discussed include the method of laying out the scrap strip, the die blocks under it, and the jig-boring dimensions that are called "step dimensions" and are used for locating the holes in the die blocks. How the jig-boring machine is used in boring the "sweeps" for the arcs and at the same time removing some of the tool steel within the opening is explained. A typical progressive die is described. *Heat Treating and Forging*, April, 1943, pages 186–188, 2 illus.

Air Corps Flashlight. A plastic-housed, plastic-lensed flashlight for ground crews, built under the direction of Army Air Corps engineers, is described. This flashlight is designed to meet the specialized demands of the various units of the Air Forces and is claimed to be both vapor- and shock-proof. The angle of the lens keeps the light from shining into the holder's eyes when the hand is held in normal position. A clip is provided so that the flashlight may be hung from the belt. A spring-mounting device holds the bulb securely in the socket. It is stated that the Army Air Corps engineers investigated a wide variety of materials before settling on the specifications of the light. Design features of the light, which is housed in cellulose acetate butyrate, are described. *Modern Plastics*, May, 1943, pages 63, 152, 154, 156, 3 illus.

Aircraft Tool Planning. Part I. Richard H. Luders. The first of two articles itemizing 20 points that make proper job analysis essential to good tool planning. Twelve of the 20 points are covered in the current article: ultimate part cost, system of coordination, attaching points (interchangeability), master tooling, importance of part or assembly, forming quality of specified material, necessary jigging, assembly location, complicated assembled structures, bench assemblies, production assemblies, and design requirements. *Aviation*, April, 1943, pages 144, 145, 147, 374, 377, 378, 5 illus.



This specially constructed dynamometer tests airplane brakes at the Bendix Products Division of the Bendix Aviation Corporation. The energy wheel is 7 ft. in diameter and is adjustable from a minimum weight of 6,684 lbs. to a maximum of 37,186 lbs. The dynamometer can duplicate landing speeds up to 120 m.p.h.

Thermoplastics for Aircraft Tools. James M. Church. Forming blocks, drill jigs, dies, and other aircraft tools made of a new plastic created by laboratory workers at the Chemical engineering Department of Columbia University are described. The new plastic, which is called Thermo-Cast, is based on a hot-melt ethyl cellulose composition, compounded with plasticizers, resins, pigment filler, and other ingredients that can be varied to form many different formulations. It is explained that outstanding properties of this plastic are good flow characteristics at melt temperature, retention of exact mold dimensions and high degree of durability, toughness, and acid resistance. Like metal, the new material can be melted and cast into shapes without the use of pressure but at considerably lower temperatures and with more exactness of mold dimensions. The writer explains how the plastic is melted, outlines the technique used for successful casting, and describes the use of Thermo-Cast tools. *Modern Plastics*, May, 1943, pages 74, 75, 140, 3 illus.

Training

Paratroopers are Tough. Lt. Seth Halton. A review of the work of Canadian paratroops and how they are trained. It is stated that the beginning of Canadian paratroops was in 1942 when a group of 25 officers and men were sent to Fort Benning to take a course given American paratroopers and qualify as instructors for the incipient Canadian battalion. The rigorous routine training given the paratrooper is related. *Commercial Aviation*, March, 1942, pages 38, 40, 42, 11 illus.

Flight Instruction in Wartime. Lt. Comdr. H. B. Jenkins. The importance of teaching the student fundamental principles rather than set rules of procedure is stressed. Perspective in flight training is emphasized, and other subjects discussed include how to cope with wind drift, wing-over, correcting errors, and making the student use all his resources. *Air Facts*, May, 1943, pages 16–20, 22–24, 1 illus.

Your Future in Aviation. Marvin Martin. Young people are advised on the opportunities for careers in post-war commercial aviation. Types of jobs that will be available with air lines are listed and suggestions on how to prepare and apply for them are given. The discussion covers general education and specialized training requirements, the importance of possessing the necessary qualifications for each job, and the methods of selecting the proper aviation schools.

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Among the jobs noted are those of: air-line meteorologists; dispatchers; radio operators and maintenance men; sales, contact, and promotion personnel. *Flying*, May, 1943, pages 32–34, 165, 5 illus.

Specialised Training. Details on two schools of specialized training under the Technical Training Command of the Royal Air Force are given. One is the Rotol School, which instructs members of British and Allied armed forces in the proper maintenance and repair of various types of propellers. Both main types of Rotol hydraulic propellers, the Curtiss electric propeller, the Rotol electric propeller, and propeller blades are among the subjects. The other school is the Dowty School of aircraft hydraulics, where technical instruction is given in the operating principles and maintenance of Dowty hydraulic equipment for aircraft. The syllabus of the two schools, teachers, students, equipment, accommodations, and accessory demonstration facilities are included. *Flight*, March 4, 1943, pages 223–225, 8 illus.; "Efficiency Through Co-Operation," *The Aeroplane*, March 12, 1943, pages 299, 300, 3 illus.

Training Army Navigators. Edward J. Ryan. The training program of Army Air Forces navigators. This article relates how the program was instituted in 1940 at Miami, Fla., describes the cooperation of Pan American Airways in supplying instructors, and outlines the 9-week curriculum. The international character of the program is established by information that cadets from England, New Zealand, Argentina, and China have participated in this aerial navigation training. *Flying*, May, 1943, pages 42, 43, 163, 164, 4 illus.

The Training Film Program of the Army Air Forces. Capt. Howard A. Gray. The development of the Army Air Forces training film program is described and the importance of the undertaking is emphasized. It is stated that a recent analysis of the courses of instruction offered in 38 representative schools indicated that there were 237 different courses of study. The training commands of the Army Air Forces are charged with the development of the program, and it is explained that responsibility for planning the slide film and training film program has been delegated to the Directorate of Training Aids, A.A.F. School of Applied Tactics, Orlando, Fla. How this organization maintains continuous contact with the Air Forces training commands for the purpose of keeping informed of new courses of study and of the need for training film materials is outlined. The writer also describes the production, distribution, and utilization of films. *Visual Review*, 1943, pages 14–16, 2 illus.

Cruising Straight and Level. Wolfgang Langewiesche. The importance to the student of learning to pilot a plane on a straight and level course is emphasized. It is stated that flight instructors and government inspectors consider straight and level flight a most revealing test of a pilot's ability. Level cruising is also important in practical flying, and the technique of straight and level flight is discussed. The writer explains how to fly by compass and how to fly in rough air, indicating the common faults and showing how to avoid doing the wrong thing, which frequently may seem to be the correct thing. Use of the rudder is emphasized, and instructions are given on how to level off and to hold altitude. *Air Facts*, May, 1943, pages 57–66.

Tennessee's Airwomen. Gene Slack. An account of the Aviation Research Instructor School for Women—an activity of the Tennessee Bureau of Aeronautics for training selected women fliers to become aviation instructors. In addition to details of their training, brief word-portraits are given of the first ten students and the people in charge of the school. The statement is made that a nation-wide extension is being urged. *Flying*, May, 1943, pages 46, 47, 128, 130, 132, 5 illus.

Training the Aircraft Engineer. Capt. J. Laurence Pritchard. The writer suggests that the British aircraft industry endow and take control of all aeronautical education. It is his opinion that, after the termination of a general education (which he puts at an age level of about 16 years), the student's specialized training should be directed by the industry for which he is preparing. This system, he believes, would provide for the ideal combination of theory and practice during the training period. The utilization of all existing educational facilities forms part of the plan. *Flight*, March 11, 1943, pages 263, 264.

Teaching Aviation Mechanic Courses with Films. A. G. Thomas. How the Airlines War Training Institute is using slide films and motion pictures to speed the training of avia-

An "exploded" view of the Fairchild AT-21 gunnery trainer powered by two Ranger twelve-cylinder engines.

tion mechanics is described. It is explained that the use of films not only speeds up the process of training but has the advantage of standardizing methods of maintenance and operation procedures so that the same routine may be taught universally, even in the most remote stations. Slide films are being used in all branches of aviation training. These consist of individual pictures, diagrams, graphs, and charts printed on 35-mm. film, each slide film dealing with a certain subdivision of that phase. *Visual Review*, 1943, page 43.

RCAF Pilot School. Bruce Keith. An organized system of preflight training—Canada's Air Cadet League—provides the Royal Canadian Air Force with a prolific source of potential pilots. The civilian background, organization, and support of the League; the methods by which it is financed; its activities, teachers, uniforms, and equipment; and the meaning of the movement to the Canadian government are surveyed. The writer also outlines the mutually adopted ten-point program that coordinates the Air Cadet League with the R.C.A.F.

The cadet's training is described as being almost identical to the initial air force instruction given an air-crew recruit during his first two months in the R.C.A.F. Courses include: administration and organization, aircraft recognition, airmanship, drill, antigas training, and armament training. *Flying*, May, 1943, pages 48–50, 146, 148, 150, 10 illus.

Training Those Who Fly by Night. An account of a British advanced flying unit where pilots who are to participate in night bombing and coastal operations are drilled in the particular problems attendant upon flying in darkness and bad weather. Ground instruction, training in the air, systems of night lights, and the use of radio are outlined. The planes and equipment used for this training period are also mentioned. *The Aeroplane*, March 5, 1943, pages 276, 277, 6 illus.

Some Soldiers Don't Shoot. Kurt Rand. As taught at the Chicago School of Aircraft Instruments, the Army Air Forces course of training for instrument repairmen is described. The article stresses the precision that is required for the techniques and tools of this work. Various types of instruments in which the student is schooled are listed, the curriculum is outlined, and the aptitudes that qualify the soldier for the course are noted. *Flying*, May, 1943, pages 62, 63, 167, 3 illus.

Southeast Army Air Forces Training Center. The purpose, operation, and accomplishments of an Air Forces Training Center are given in this article on the Southeast Army Air Forces Training Center, largest of the three United States Centers. It surveys the establishment, organization, growth, methods, and program of the Southeast Center. It also describes some of the men responsible for its development and those in charge of its activities. Salient facts in the history of Maxwell Field, headquarters of the Center, are recounted. The syllabus of each stage in a pilot's training is outlined briefly—from his classification tests (where it is decided whether the neophyte will study to be a pilot, navigator, or bombardier) through preflight, primary, basic, and advanced instruction. The training given in navigation, aerial gunnery, mechanics, and gliding is included. *The American Pilot and Aircraftsman*, April, 1943, pages 7–16, 19–26, 49 illus.

The B-19 and Army's Culver both profit by this comparison. When this view was taken about a year ago, the B-19 was the Army's largest ship. The Culver was then and still is the Army's smallest plane. An idea of the comparative size of these two units is gained when the diameter of the B-19 propeller is compared with the overall length of the Culver.

Warfare

Squaring the Circle. In this discussion of war strategy the writer states that the air phases of warfare are often plotted in terms of circles. Considering the European war theater, he indicates that the spotlight circle extends from a center placed at Munich. This area has become the sphere of operations for Allied air attack. Operations against the enemy are described and analyzed. *Air News*, April, 1943, pages 14–18, 9 illus.

Lightnings in Africa. Capt. William J. Hoelle. A P-38 pilot describes several episodes on the African front which illustrate the fighting characteristics of the Lockheed Lightning. He refutes criticisms of this twin-engined interceptor with regard to sufficient fire power, use as a ground-support airplane, single-engined operation, and opportunity for the pilot to bail out in combat. Battle tactics of the P-38 against Focke-Wulfs and Messerschmitts are noted, and the versatility of this American plane is supported by a report of its alternate applications as a ground strafer, light bomber, tank destroyer, and convoy for big bombers. *Flying*, May, 1943, pages 24, 25, 136, 138, 140, 4 illus.

The American Approach to Japan. Capt. Norman Macmillan. The problem of conducting air operations against Japan is considered with particular reference to flight distances from Allied bases. Both military transport and bombing operations are discussed. Methods used by the enemy strategists in Norway, Holland, Tunisia, and Crete are reviewed. It is stated that the most practical direct land hemisphere approach to Japan lies across China. A map is included showing the distances involved in Allied attacks on Japan from the Philippine Islands and the South Pacific Islands. A map of the land hemisphere of the world also is included to show the battle fronts and their relationship to one another. *Aeronautics*, April, 1943, pages 28–32, 2 illus.

Fighters and Fighter-Bombers. Major F. A. de V. Robertson. A report of two visits to Royal Air Force air stations, with the purpose of each squadron designated and the operational record of each reviewed. The first is Number 609 squadron—formerly belonging to the auxiliary air force—equipped with Hawker Typhoons. Its operations include interception against enemy raiders, night intruder work, and daytime attacks on railway transports in Belgium and France. The second is a fighter-bomber squadron equipped with Westland Whirlwinds. In addition to outlining the salient features of the Whirlwind, the article describes the squadron's activities in attacking ground and sea targets. *Flight*, March 11, 1943, pages 252–254, 5 illus.; "Typhoons and Whirlwinds at Work," *The Aeroplane*, March 12, 1943, pages 312, 313, 2 illus.

Norway's Air Force. This article on the Norwegian Squadrons of the R.A.F. deals not only with the organization and operational record of the Norwegian Air Force under the R.A.F. but also with the training given to Norwegian pilots in Canada, the equipment used, the hardships with which the men reached Great Britain, and their multiphased air activities. *Flight*, March 11, 1943, pages 255, 256, 4 illus.

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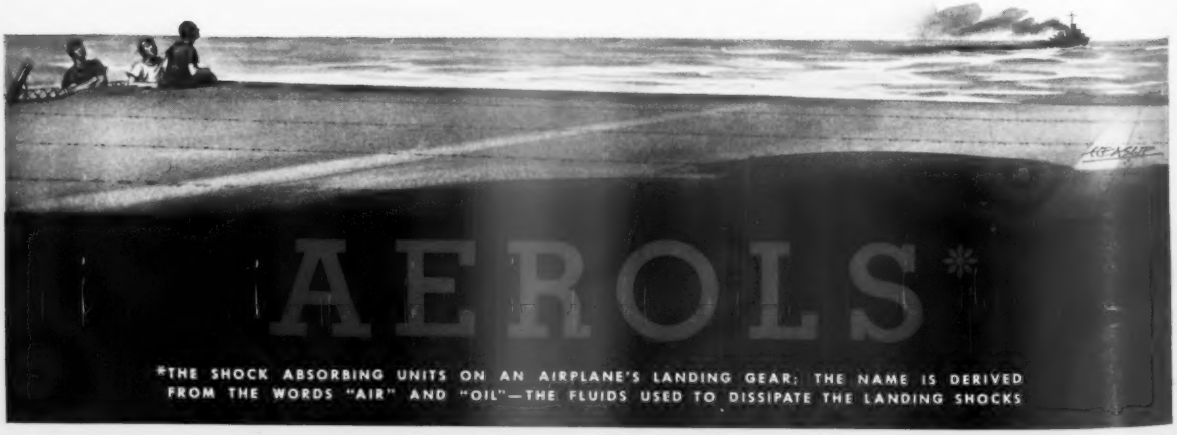


*THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR; THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL"—THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS

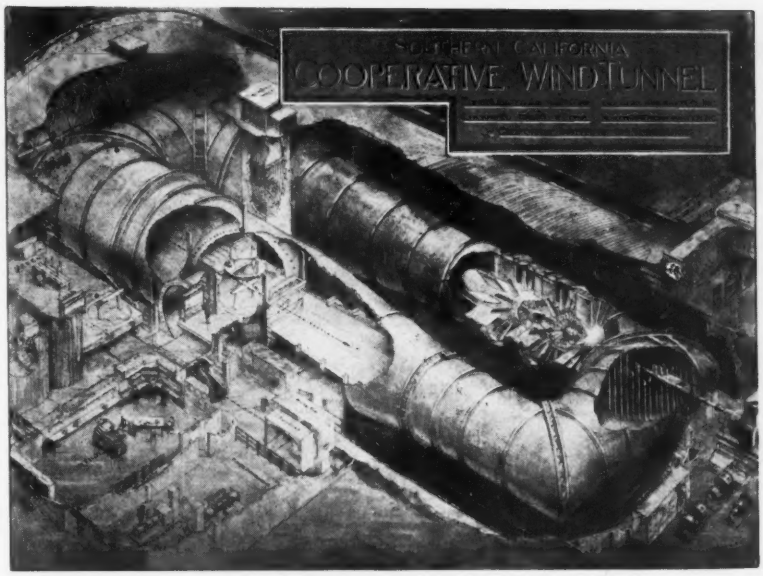
Welding

Arc Electrode Usage to Increase War Effort. C. J. Holslag. Tabulated data are given on electrodes for arc welding. An alphabetical list of ingredients of welding rod coatings and their possible functions, follows a brief historical outline of the subject. It is noted that old-fashioned covered electrodes had a thick tenacious coating that had to be chipped off, while modern covered electrodes are easier to run and do not have to be chipped. *The Welding Journal*, April, 1943, pages 250, 251.

Treatment of Fusion Welds. A. J. T. Eyles. Some advice is given on the treatment of fusion welds. The progress made during the past few years in fusion welding practice and technique has resulted in the increased use of welded components in the aircraft industry and others. A fusion weld, however, is only a casting, and either mechanical or thermal treatment or both, when carried out correctly, will invariably be beneficial. It is shown that a copper weld, for example, has only the strength of cast copper, but its tenacity can be increased by cold hammering and the weld also should be annealed whenever practicable to relieve strains and restore homogeneity of structure. It is also beneficial to hammer welds in aluminum.

The problems of fusion welding duralumin and other heat-treatable alloys are somewhat different and are discussed briefly. The technique of fusion welding magnesium-base alloys does not differ radically from that of welding aluminum alloys, but a clear understanding of their characteristics is required. The methods of welding magnesium-base alloys are discussed. Proper temperatures are given for welding brasses and for welding and heat-treating stainless steels. *Sheet Metal Industries*, April, 1943, pages 691, 692.

The Application of Copper-Oxide Rectifiers for Resistance Welding. R. L. Briggs. It is stated that because of the limiting capacities of available single-phase power systems for welding loads there has been increasing interest in the use of three-phase systems for resistance welding. An examination of possible methods of obtaining sufficient current in amperes for resistance welding indicates that dry-type rectification of a three-phase, low-voltage, high-current system is practical. The writer describes such a system and illustrates its operating characteristics and applications to a given job. *The Welding Journal*, April, 1943, pages 252–256, 9 illus.



This wind tunnel will incorporate the most advanced technical improvements and will provide wind velocities up to more than 700 m.p.h. The tunnel will be operated by the California Institute of Technology for research and development problems of the cooperating companies, and its facilities will be made available to other member companies of the Aircraft War Production Council by special arrangement. A similar tunnel is being constructed in the East by Curtiss-Wright.

Miscellaneous

Bevel Gears in Aircraft. Part 1. Allan H. Candee. Based on a paper presented at a recent meeting of the Aviation Division of the American Society of Mechanical Engineers, this is a study of some of the important applications and advantages of bevel gears in aircraft. Considered in detail are the applications of bevel gears: in the main drive from engine to propeller, for two coaxial propellers rotating in opposite directions, and in variable-pitch propellers. Other miscellaneous applications are listed. The writer stresses three important features of bevel gears that differ from other types of gears and are of value in aircraft construction: first, their conical form; second, their great flexibility in tooth design; and third, their characteristic tooth bearing, in which contact is kept away from the ends of the teeth.

Topical discussions in the article come under the following headings: Propeller Drives, Efficiency of Planetary Drive, Drive for Coaxial Propellers, Driving Arrangement of the Future, Advantages of Bevel Gears, Requirements for Gears in Aircraft, New Testing Equipment, and Miscellaneous Applications. *Aero Digest*, April, 1943, pages 167, 169, 170, 175, 176, 254, 256, 16 illus.

Theory and Technique of Perspective Projection. Part III. George F. Bush. The third of a series of articles on the fundamentals of graphic projection is devoted to a consideration of three-point perspective and the Bush Superposition Method. The three-view perspective is defined and explained. The writer states that one type of perspective is original with him and represents a simplification over previous methods with respect to the time required and the number of complete lines necessary. The second type differs from former, conventional methods in respect to the manner in which the piercing points are obtained. Detailed instructions are given by numbered steps for the use of the process and its application to practical work. *Aviation*, April, 1943, pages 171, 172, 174, 368, 371, 7 illus.

15th Annual Directory of American Aircraft and Engines. The first section of this annual issue contains directories of aircraft and engine manufacturers, propeller manufacturers, and the executive personnel of the air lines. Specifications and performance data on civil aircraft in use and an index of military aircraft, classified according to type, are included in this section. The second section is offered as a complete compilation of released data on American military aircraft, with photographs and three-view drawings. In the third section specifications and performance data are given on American civil aircraft. Photographs and three-view drawings illustrate this material. Specifications for aircraft engines are listed in the fourth section. *Western Flying*, April, 1943.

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Government Publications

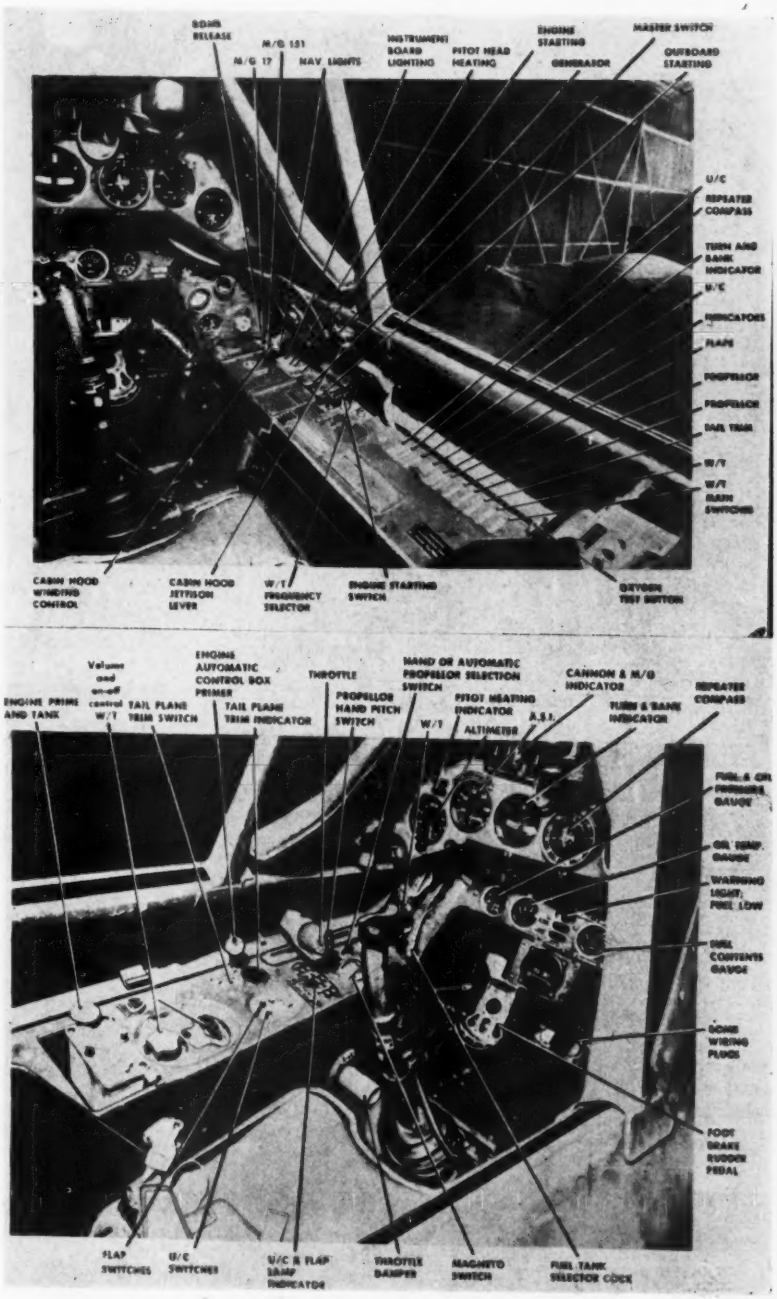
Army Air Forces

"Flight Strips" Their Development from 1935 to 1942 is the title of a pamphlet containing a selected annotated bibliography prepared by the Army Air Forces Library. It is divided into sections covering Government publications (this being subdivided into legislation and miscellaneous), and books and magazine articles as well as newspaper stories and editorials.

Fishing from the Sky. Capt. Harold B. Ingersoll. A review of the special techniques employed by the Antisubmarine Command of the U.S. Army Air Forces to combat U-boats. It is stated that releasing depth charges from extremely low altitudes is the customary method of attack. If the plane's gunfire is brought into play, it is usually directed at the conning tower or deck guns of the submarine.

As outlined by the article, the Antisubmarine Command prepares its personnel in these special techniques by training them in recognition of enemy submarine types, approach and attack procedure, identification of points of vulnerability to gunners and bombardiers, and instruction in related subjects pertaining to the particular duty to be performed. Navigators must learn special methods employed in overwater navigation. *Air Force*, May, 1943.

Compressibility. Col. Ben S. Kelsey. The fourth of a series of articles on compressibility is concerned with the effects of drag. Early assumptions that drag would eventually build up to a sufficient extent to limit the level flight and diving speed of an airplane are stated to appear incorrect, since speeds continue to increase and the point of terminal velocity has not yet been reached. Aside from the wake behind local compressibility effects, it is stated that the two biggest problems are those connected with lift and control. Limitations on the lift are discussed with reference to the changes in the characteristics of lift and pressure distribution over the upper and lower surfaces of the wings, with allusions to similar effects found in the movement of bullets, boat hulls



Courtesy "Air Force" Editorial Office

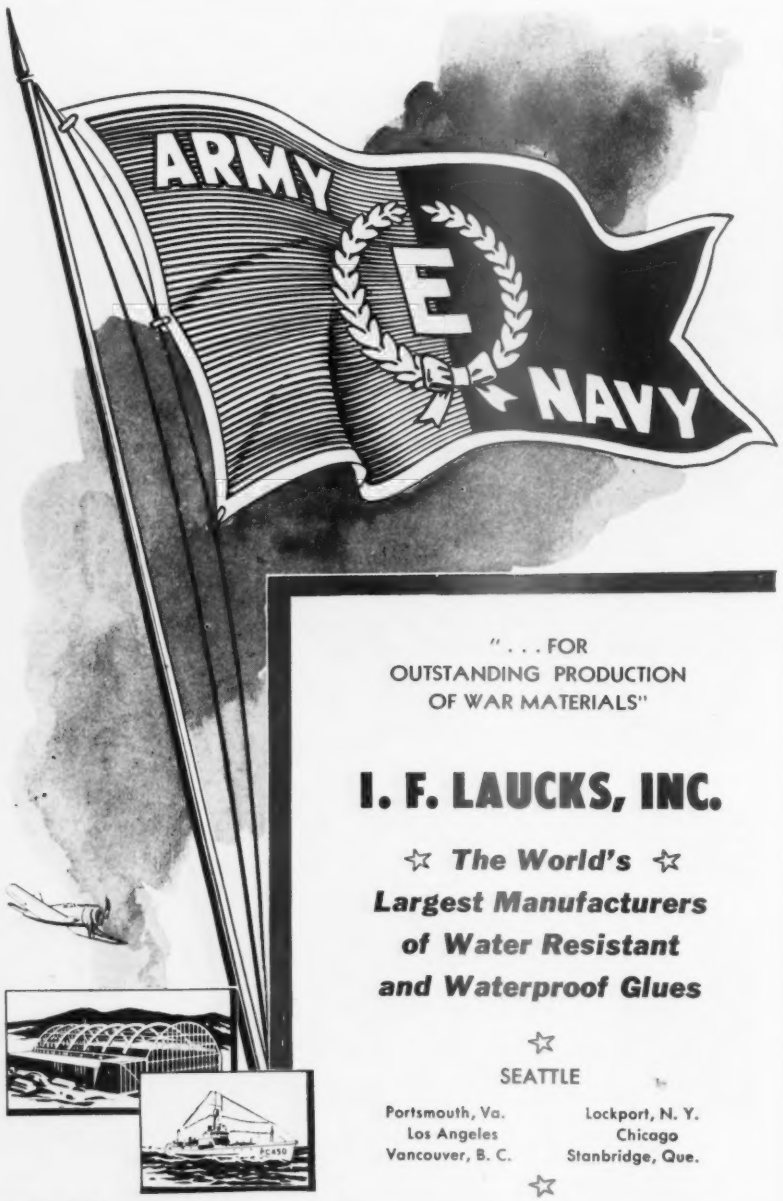
Photographs above show the cockpit of the Focke Wulf 190 with the various instruments labeled in English. Pilots of this German fighter have fewer instruments to work with than pilots of the average American plane.

and the operation of high-speed cams.

The manner in which different forms of wings have a bearing upon compressibility are outlined, as well as the forces that are imposed upon the control surfaces of the aircraft. Suggestions are made for approaching the problems involved in supersonic speeds in connection with future designs. The biggest problem is stated to be the matter of providing sufficient thrust to move an airplane against the drag at such high speeds, it being stated that the conventional propeller is more subject to compressibility than is the airplane as a whole. Jet effects, rockets, and other means for propulsion are briefly mentioned. Another problem is the action of the air forces upon the structure of the aircraft. The writer maintains that these problems will be solved and that the challenge of high speed will be met despite the obstacles to be overcome. *Air Force*, May, 1943.

Why Black-Out? Major G. W. Holt. A study of the sensory and physiologic effects imposed by acceleration upon flying personnel. Explanation of acceleration forces developed in flying is divided into three general types: linear, radial, and angular acceleration. The writer reaches the following conclusions: (1) Acceleration is of primary importance in consideration of flying problems. (2) Threshold or black-out tolerance to positive acceleration is about 5.5 G's for 4 or 5 sec. for the average man. (3) Negative acceleration sustained in outside loop maneuvers is dangerous in excess of three G's. (4) Tolerance to acceleration is partially dependent on general physical condition of the individual. (5) By assuming a crouch position or by using tiltable seats or other antigravity devices under development, fliers can increase their tolerance to acceleration. (6) Deceleration of high magnitudes is a major cause of serious—and often fatal—head injuries, the resultant concussion frequently preventing occupants from escaping fallen aircraft that burn or sink at sea. (7) Measures may be employed in reducing magnitude of deceleration in head injuries to a point where such injuries are negligible. *Air Force*, May, 1943.

We Fought Both Nips and Nazis. Major Max Fennell. An American pilot reports on his experiences fighting in China, India, and Africa. Several of his comments contain advice on combat tactics against German fighters and in different climates. He states that for a heavy bomb squadron efficient gunning is the only form of successful action against Messerschmitts. He also admonishes B-24 pilots to understand thoroughly the Liberator's hydraulic and fuel systems. *Air Force*, May, 1943.



National Advisory Committee for Aeronautics

Theoretical Determination of Axial Fan Performance. E. Struve. Report No. 295 of the Central Aero-Hydrodynamical Institute, Moscow, 1937. This report presents a method for the computation of axial fan characteristics. The method is based on the assumption that the law of constancy of the circulation along the blade holds approximately for all fan conditions for which the blade elements operate at normal angles of attack, up to the stalling angles. Pressure head coefficient and power coefficient for the force components in the axial and tangential directions, respectively, and analogous to the lift and drag coefficients are conveniently introduced. Comparison of two of the expressions used enables the determination of all magnitudes characterizing the blade element performance and the performance of the fan as a whole. The report can be divided into five parts: (1) exposition of the blade element

Consternation reigns in Axis ranks when Army B-26 bombers loom up. These versatile Martin Marauders can carry bombs, torpedoes or depth charges, plus the fire power to strafe or battle as fighters, plane to plane. Their mighty Double Wasp engines pack 2000 horsepower each, to help make them the scourge of the skies.

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THERE'S something about a perfectly performing aircraft engine that makes a pilot's eyes shine. Unconsciously he is probably reflecting the confidence he places in it.

He undoubtedly does not think of its marvelously ingenious construction, the vital roles played by hundreds of precision parts each with its own specific job to do. No, to him it's one single mechanical marvel, with a distinct personality, which he has learned to know and respect because he has found it dependable in situations involving life or death.

The Champion Spark Plugs we manufacture for use in aircraft engines of every size are built with this in mind. Ours is just one component with one vital job to do in any engine it goes into. But it is a vital product—vital because it must not fail. We never want that light in a pilot's eyes which bespeaks his silent trust in us to be suddenly extinguished by the bitter disillusionment which failure of our product would mean.

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C26—Unshielded

theory based on the general laws of mechanics and on the fundamental coefficients of experimental aerodynamics, respectively; (2) discussion of the physical basis of the phenomena in fan operation and generalization to different operating conditions; (3) explanation of the new modification of axial fan computation, whereby use is made of the pressure and power coefficients; (4) method of determination of axial fan performance; and (5) comparison of theoretic with experimental results and discussion of several conclusions drawn therefrom.

Comparison with experiment shows that the method presented permits construction of that portion of the axial fan characteristic lying within the range of maximum efficiency with an accuracy sufficient for practical purposes. There is brought out the need for further detailed study of an airfoil situated in a flow having a rotational component and of the mutual interference of the blades of a cascade in order to obtain further accuracy in the method described. In this connection a method is outlined for obtaining the aerodynamic characteristics of the airfoil from the fan characteristics. An approximate method for plotting the fan characteristics, which does not involve much computation work and may be used for tentative computation, is also presented. *N.A.C.A. T.M. No. 1042*, April, 1943.

Experimental Investigation of a Model of a Two-Stage Turboblower. S. Dovjik and W. Polikovsky. Report No. 191 of the Central Aero-Hydrodynamical Institute, Moscow, 1935. An investigation is made of two stages of a multistage turboblower having a vaneless diffuser behind the impeller and guide vanes at the inlet to the next stage. The method employed was that of investigating the performance of the successive elements of the blower (the impeller, vaneless diffuser, etc.) whereby the kinematics of the flow through the blower could be followed and the pressure at the different points computed. The character of the flow and the physical significance of the loss coefficients could thereby be determined so as to secure the best agreement of the computed with the actual performance of the blower.

Since the tests were carried out for various delivery volumes, the dependence of the coefficients on a number of factors (angle of attack, velocities, etc.) could be obtained. The distribution of the losses that occur during the transformation of dynamic pressure at the impeller exit into static pressure could be found and likewise the range within which the friction coefficient varies in the vaneless diffuser. With the aid of factors having a certain physical significance, the centrifugal blower could be computed on the basis of a more or less schematic consideration of the phenomena occurring during the airflow through it and the use of arbitrary factors and recourse to the geometric similitude law thus avoided. The present investigation largely summarizes all the previous work of the Central Aero-Hydrodynamical Institute Blower Section on the different elements of a centrifugal blower. Some considerations on the analysis of model test data for application to full scale are presented in the appendix. *N.A.C.A. T.M. No. 1043*, April, 1943.

Heat Transfer of Airfoils and Plates. Otto Seibert. Translation of an article "Wärmeubertragung von Profilen und Platten," from *Jahrbuch 1938 der deutschen Luftfahrtforschung*. The few available test data on the heat dissipation of wholly or partly heated airfoil models are compared with the corresponding data for the flat plate as obtained by an extension of Prandtl's momentum theory, with differentiation between laminar and turbulent boundary layer and transitional region between both, the extent and appearance of which depend upon certain critical factors. The satisfactory agreement obtained justifies far-reaching conclusions with respect to other profile forms and arrangements of heated surface areas. The temperature relationship of the material quantities in its effect on the heat dissipation is discussed as far as is possible at the present state of research, and it is shown that the profile drag of heated wing surfaces can increase or decrease with the temperature increase depending upon the momentarily existent structure of the boundary layer. *N.A.C.A. T.M. No. 1044*, April, 1943.

Civil Aeronautics Administration

Aircraft Structural Testing. B. L. Springer. Problems connected with the structural testing of aircraft structures are reviewed and test methods commonly employed by the aircraft industry today are summarized. The excellent structural record of United States aircraft equipment under all kinds of operating conditions is stated to be due in no small part to the program of structural testing to which every airplane type design is subjected prior to being put into production. In order to give a general picture of the extent of structural tests of a modern airplane, an outline of a typical program of tests is given. The writer continues with a discussion of loading systems, strain gauges, the testing of wood aircraft, pressurized cabins, and windshields. Other sections cover drop tests, operating tests, vibration and flutter tests, and model tests. It is concluded that, with the increase in size of aircraft, jigs and loading devices of unprecedented size will be required. For the huge airplane of tomorrow the structures may be so large that it will be more practicable to rely on section tests or model tests.

The most satisfactory method of increasing the pay load of the aircraft seemed to be in utilizing every bit of overstrength in the aircraft structure. Strength testing appears to be the only direct and practicable manner for measuring this. It is stated that the expense and trouble of such tests can be repaid many times over during the life of a fleet of airplanes if only a few per cent increase in pay load results. This consideration will undoubtedly induce aircraft manufacturers to conduct far more structural tests than heretofore have been felt necessary. *Civil Aeronautics Journal*, April 15, 1943.

Civil Aeronautics Board

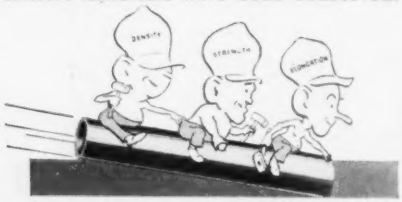
The Civil Aeronautics Board recently issued an order instituting an investigation of "local feeder pickup" air service to determine the extent to which air transportation can be extended to smaller communities. The Board's investigation relating to such service will open such questions as the methods of operation, types of flight equipment necessary, airports and other facilities required, the allowable cost to the Government of such service, proper means of assuring that such service shall maintain its local-service character, and, in general, conditions upon which authorizations may be granted.

Through its order instituting the investigation of local air service, the Board expects to give to leaders in the field of American aeronautics an opportunity to contribute their accumulative experience so that it may be utilized in planning for local air service development. The entire aviation industry, the Administrator of Civil Aeronautics, the Post Office Department, all state aviation bodies, all domestic air carriers, all applicants for domestic air transportation certificates, aircraft manufacturers, trade associations, and airport managers have been notified of the Board's investigation and will have the opportunity to attend a public hearing to be held at a future date before an Examiner of the Board.

Thirty-eight applications have been received by the Board, mostly within

New Uses for SHENANGO-PENN *Centrifugal Castings*

WARTIME production demands have led aviation engineers to a greater reliance upon centrifugally cast products. Parts formerly forged are now being turned out in rapidly revolving molds. In many cases, product performance has improved; in all cases, finished production time has been reduced and critical materials have been conserved.



Shenango-Penn castings can probably be used wherever wheels turn or where wearing or corrosion exist. Because the process is so flexible, it is possible to furnish flanges and to work out unusual shapes and sizes. Our standard alloys meet all Army, Navy and Air Corps specifications—and are constantly tested and checked in our own laboratory.

Why not call on our metallurgical and engineering experience to determine whether there are new uses possible in your production?

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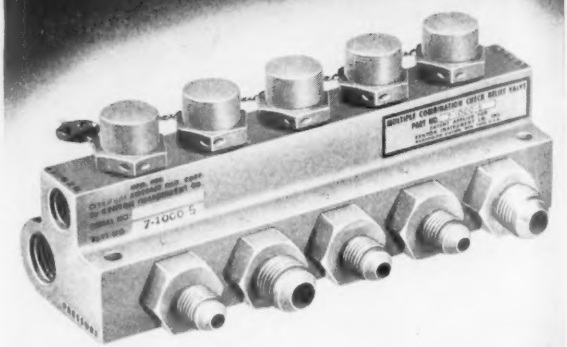
SHENANGO - PENN

The boys just naturally called it the

"PICCOLO" VALVE



It started out as the Kenyon Combination Multiple Check-Relief Valve Assembly—but the boys who worked on it had a better idea.

So now it's the Kenyon "Piccolo" Valve.

More important than the name is the fact that it provides in a single housing a multiplicity of valve units (as many as 16), all of which discharge into a common return line. Used in the high-pressure hydraulic valve systems of military or commercial aircraft, the "Piccolo" Valve

★ centralizes the thermal expansion relief valves of several closed hydraulic systems.

★ costs less than an equal number of single valve units.

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Full construction details and specifications of the "Piccolo" Valve supplied on request. We also solicit inquiries on all types of precision aircraft instruments.

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If it's Kenyon-made KENYON *it's precision-built*

the last year, for certificates to carry mail, express, or passengers, or a combination of the three, between small cities and towns, including flight pickup operations in which the airplane uses a patented device to pick up mail or light cargo without landing. Only one carrier is now authorized to operate pickup service, and it covers 115 cities in six eastern states.

Office of War Information

Handbook of Emergency War Agencies has been published as a guide to Federal agencies all of whose present functions are devoted to the prosecution of the war. Activities of agencies originally established for other purposes are not included, even though much of their present work has now become connected with the war program.

The book includes organizational outlines and the names and addresses of officials of emergency war agencies, as well as the War and Navy departments and the U.S. Maritime Commission. It is intended to help the public to reach the services needed within those agencies, and for this reason all divisions of each agency are not necessarily included.

It covers not only the emergency offices and departments but the joint boards and committees and gives the street locations of prominent buildings in Washington. There are indexes of the individual units and an alphabetical listing of the names of the officials.

Copies are available through the Superintendent of Documents, Washington, D.C., at $0.20.

War Manpower Commission

The third of a series of bulletins prepared by the National Roster of Scientific and Specialized Personnel gives an analysis of the personnel situation in various scientific and professional fields based upon data obtained prior to March 1, 1943. The report, titled "The Personnel Situation in Engineering," contains information in text, tables, and charts on the distribution of engineers and of new graduates according to the fields of specialization; faculty members and student enrollment in engineering colleges; proportion of students committed to the armed forces; and estimated current engineering employment and future needs. Figures are also given on the enrollment of part-time and evening students in a similar manner. The results of a survey of anticipated needs in the different engineering fields are discussed and tabulated according to the different types of engineering courses.

Michigan State Planning Commission

Sky Camps. A booklet has been published by the Michigan State Planning Commission to show the location of recreational areas in Michigan and the flying distance from important centers in nearby states. It gives information on the equipment and facilities of recreational areas and reviews developments affecting private flying.

Statistics are also included on recreational airports and airways throughout the United States. Plans for the future development of vacation facilities are outlined, with particular emphasis on the use of privately owned aircraft as the means of transportation for reaching them.

City of Minneapolis Board of Park Commissioners

A study of the air-terminal facilities of the city of Minneapolis has been issued in the form of a 32-page booklet. Subjects covered include aviation prior to and during the war, anticipated postwar developments, the estimated potential domestic air carrier traffic and revenues, the capacity of airports, the terminal building, the Wold-Chamberlain Field, and possible additional sites.

British Information Services

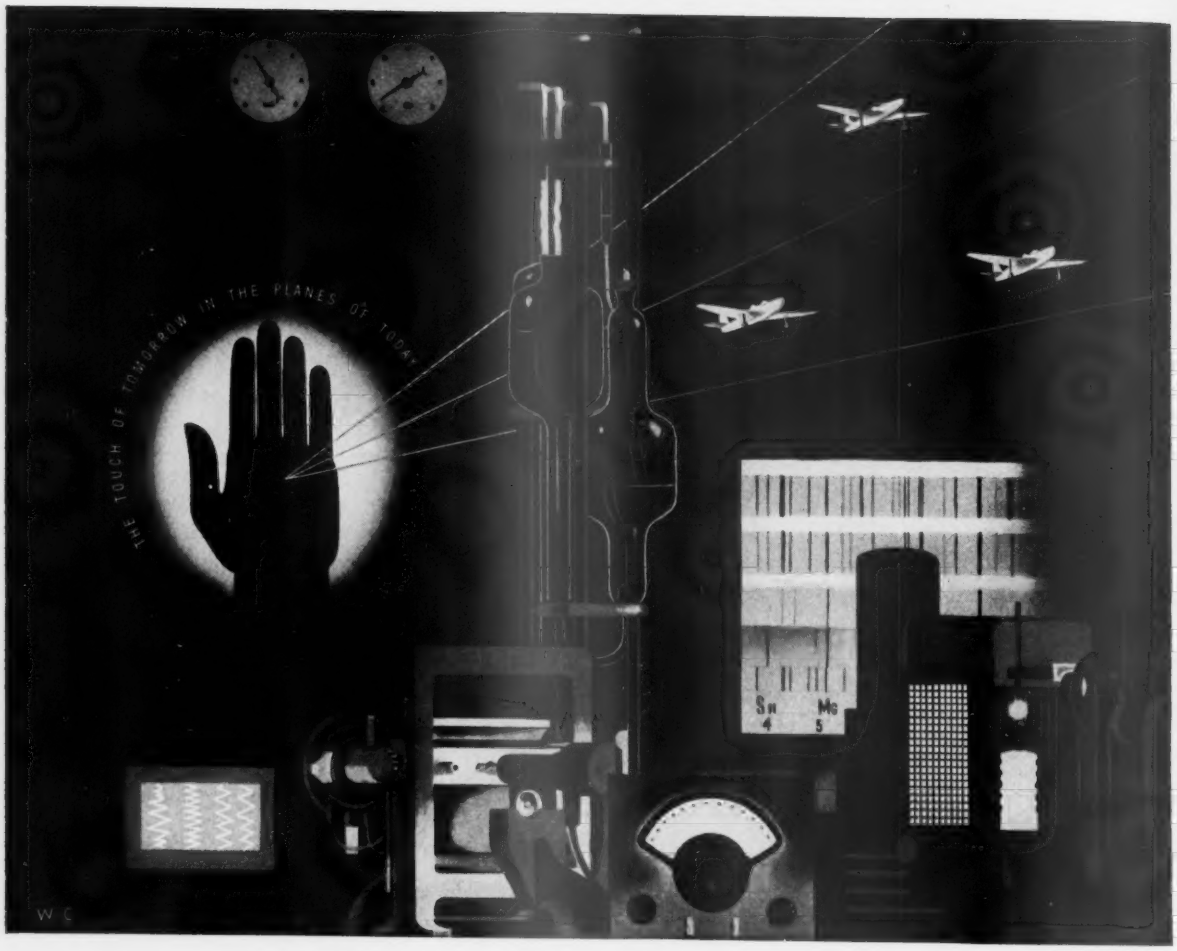
Electrode Potentials of Metals. A. H. Turnbull and H. C. Davis. A study was undertaken to determine the solution potentials of metals and alloys in sea-water and salt solutions in connection with the general problem of corrosion at contacts between dissimilar metals. Another purpose was to check potential values obtained by an earlier method for various metals and alloys. Differences in potential were measured between certain metals and a saturated calomel electrode that served as a standard. Comparison would then show the actual potential difference between any pair of dissimilar metals. Approximately 50 metals, alloys, and plated specimens were examined in condition "as-received" and after their surfaces had been abraded with emery paper. Sea water was used as the electrolyte in the first series and a 3 per cent sodium chloride solution was used in the final series. Potentials were measured at intervals over an immersion period of 24 hours, all measurements being made with the electrolyte at a temperature of 22°C.

It was found that with the exception of silver-plated copper all specimens examined were electronegative with respect to the saturated calomel electrode. Nickel and its alloys were the least negative, followed in order by chromium steels, copper and its alloys, aluminum alloys, cast iron, mild steel, zinc alloys, and magnesium alloys. The magnesium alloys were found to have the most negative potentials of all the metals examined.

A further conclusion is that when two dissimilar metals are placed in contact in the presence of sea water or salt solution the potential difference between them causes galvanic corrosion of the more negative metal. The measured values of the electrode potentials can be used to predict which metal or alloy of a dissimilar pair will suffer galvanic attack when exposed to salt solution. Because of film formation and other polarization effects in the surfaces of the metals, a large potential difference does not necessarily give rise to a large corrosion current; hence, no conclusions can be drawn regarding the extent of the galvanic attack, inasmuch as this depends upon the magnitude of the corrosion current. *Ministry of Aircraft Production, Aeronautical Research Committee, R.&M. No. 1901*, British Information Services, New York, N.Y., $1.05.

R.A.F. Log Book. Accomplishments of the Royal Air Force are set forth in an illustrated logbook. The unbroken record of Britain's growing air power is reviewed. Sections of the booklet deal with the Fighter Command, the Coastal Command, and the R.A.F. overseas. Charts show the number of German aircraft destroyed over Britain and the surrounding seas by fighter aircraft during 1940 in contrast to the losses of British fighters; the increase in the size of British bomber forces from 1940 to 1942; and the increase in maximum bomb loads carried by British heavy bombers over the period from 1940 to 1942.

Tactics of Air Offensive in the West. Brig. Gen. H. S. Sewell. A brief article gives an analysis of the types of British aircraft used in the attacks on western Germany and the occupied countries of Europe. The particular qualities of the Lancaster Sterling, Halifax, Flying Fortress and Liberator are discussed, with special reference to the kind of service for which each type is suited. Information on the assignments undertaken by the Boston and Ventura and other medium bombers is also given. In a similar manner the missions for which the Hurribomber, the Worldwind, and the Mosquito were planned are outlined. Information is given on the general strategy of the British Bomber Command and the targets upon which its efforts are centered. *Britain*, April, 1943.



Organizing Atoms for a Better Aircraft Engine

A visitor at the Ranger plant once remarked: "Scratch a Ranger engineer and you'll find a scientist!" In creating the Ranger in-line, air-cooled aircraft engine, Ranger engineers began by concerning themselves with the very atoms of which its metal alloys are composed. They made use of scientific instruments and techniques unexcelled anywhere in the world in scope and precision. And the same advanced metallurgical and chemical laboratory facilities are today guarding the quality of Ranger materials in the rush of war-time production. Spectroscopic, chemical and X-ray analyses of materials and finished parts are as much a part of Ranger production as milling machines, turret lathes and grinders.

All Ranger engines are put through the acid test of actual operating conditions in scientifically equipped test cells. Ranger's experimental test cells can simulate flying conditions in temperatures as low as −70° F. and at altitudes up to 40,000 feet. Some of Ranger's tests on auxiliary devices are not duplicated anywhere in the aviation industry. In Ranger's "flying laboratory"—a tactical war plane fully equipped with scientific test instruments—pilots and engineers daily add new knowledge to all that has been discovered before.

While thousands of Ranger engines are turning in a remarkable record in the planes of the United Nations, Ranger engineers persist in researches which will make even more readable news tomorrow . . . except in Axis newspapers.

"ON THE BEAM"

"The independence and liberty you possess are the work of joint councils and joint efforts, of common dangers, sufferings and successes."

—Geo. Washington. Farewell Address

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BOOKS

The Wright Brothers

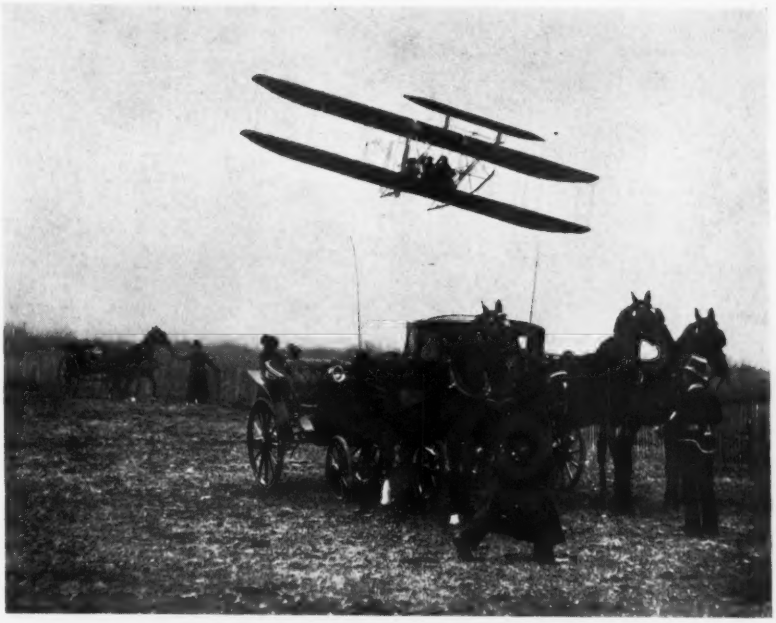
Fred C. Kelly

Chapters

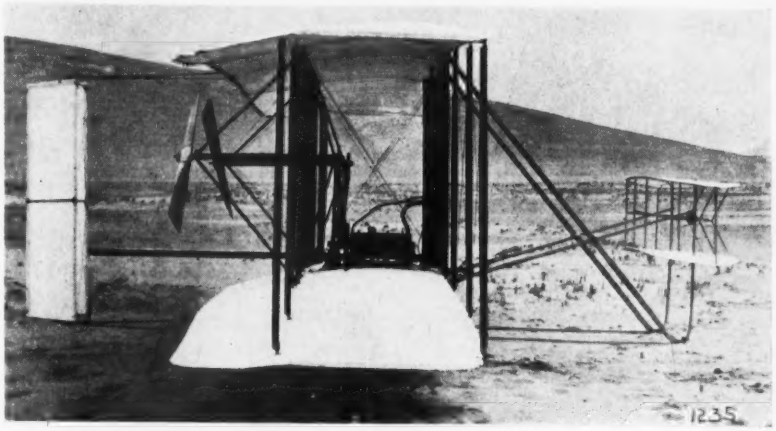
Boyhood
Background
Printing—and Bicycles
First Thoughts of Flight
Gliding at Kitty Hawk
First Power Flight
After the Event
Experiments of 1904–'05
It Still Wasn't "News"
U.S. Army Not Interested
Europe Discovers the Wrights
The Wrights in Europe
A Deal with the U.S.
End of Disbelief
When Wilbur Wright Won France
Further Adventures in 1909
In Aviation Business
Patent Suits
Why the Wright Plane was Exiled

Since the memorable December 17, 1903, when the Wright Brothers made their four flights at Kitty Hawk, the public has read fanciful and inaccurate stories in newspapers and books regarding the work of these men who not only devised the first successful powered flying machine but taught the world how to operate airplanes. For nearly 30 years writers have tried to persuade Orville Wright to approve their interpretations of this epic of American inventive genius. But, invariably, they had repeated so many of the legendary reports that to authorize would have meant rewriting, and anyone who knows the first citizen of Dayton knows his aversion to such effort.

Fred C. Kelly tried a new method. He talked with everyone he could locate who knew anything about the early life of the Wright family. He talked with their business associates. He searched the newspaper files for chronologic information but accepted nothing as true. Then he gained the confidence and interest of Orville Wright, who respected his painstaking research and intense desire for accuracy. It was while making his inquiries that he became the intermediary between The Smithsonian Institution and Mr. Wright which resulted in the issuance of the statement by Dr. C. G. Abbott, Secretary, regretting that this great national scientific group had been misled into spreading inaccurate reports regarding flights of the Langley Aerodrome, and mislabeling it to the disparagement of the Wright machine and reputation.



Wilbur Wright with passenger, Pau, France, 1909.



Side view of the famous Wright Brothers Model "A" plane on the sand dunes at Kitty Hawk, N.C., in which Orville Wright made the first flight ever made by man in a power-driven airplane under full control on December 17, 1903.
The Wright Brothers designed their own engine. C. E. Taylor, their machinist, built it.

The chapter that explains why the Kitty Hawk airplane was sent to England gives, for the first time, the reasons for the expatriation of one of the greatest relics of modern invention. If the publication of the book prepares the way for the eventual return of the machine to this country, it will have accomplished a most worthy result.

The early chapters of the book are inspirational in showing how, from a typical Midwestern household, there emerged two of the world's best known inventive minds. The years spent in experimental work at Kitty Hawk and at the Huffman pasture near Dayton are recounted with a greater accuracy of detail than has appeared before in print.

The lack of appreciation by the Army for flying machines, after the Langley failure, and the suspicion of all

FLEETWINGS

pioneers with parts and hydraulic equipment

The BT-12, all-welded basic trainer built for the U. S. Army Air Forces.

FLEETWINGS' "SUGGESTION CAMPAIGN" continues to bear bitter fruit for the Axis. In one week, recently, ten Fleetwingers were awarded cash prizes for their ideas on how we might up our output for Victory.

TOP PRIZE FOR THE WEEK went to a man in the Hydraulics Laboratory. His suggestion was a modification in design of certain Fleetwings' hydraulic valves. As a result, it is now possible for us to turn out more valves than ever before... with no decrease in quality of the finished units. Basically the idea involved simplification and standardization which permitted interchangeability of parts, reduced machining time, eliminated the necessity for certain tests, and cut spoilage to an absolute zero.

ANOTHER SUGGESTION was a new way for making patterns on a machine tool. Here, too, considerable time is saved since the new method is noticeably more efficient than that used previously.

TO KEEP UP with these aircraft developments, we invite you to send for the Fleetwings publication known as "The Arrow." This bulletin is sent monthly to officials in the industry without charge. To get your copies regularly, merely write us on your company stationery. Send the request to "The Arrow" at Fleetwings' Plant Number Two.

"KEEP 'EM FLYING!"

FLEETWINGS

Division of Kaiser Cargo, Inc.

BRISTOL • PENNSYLVANIA

other proponents was not only typical but forced the Wrights to consider offers from Europe. These negotiations are related in chapters that will be interesting as the true story of how the aircraft industry started from such primitive beginnings and grew until it ranks as the greatest this country has ever known. It is a romance of business as well as basic aviation history.

After an incredulous world accepted the Wrights as the true pioneers of flight, the beginning of our ever hampered air power took place. France, England, Italy, Germany, and Russia succumbed to the lure of the sky and rival inventors did their utmost to belittle the achievement of the two bicycle builders of Dayton.

Through it all, as Mr. Kelly shows, the Wright Brothers followed a straight course. They knew that their methods of securing stability in flight were the only ones that could be successful, and they upheld their claims against all contenders, in courts and in negotiations.

No book that is authorized by one of its chief figures can be considered "exparte." No pretense is made that it is more than a factual presentation of the correct point of view of the long struggle of the Wright Brothers for recognition. The Archives of the Institute were used freely by the author for checking facts and reading related material. The Hart O. Berg Collection of Early Wrightiana is probably the most complete source of reference in this country, excepting only the vast files at the Wright Laboratory in Dayton.

If some technical writer could prepare a summary of the engineering and scientific successes of the Wrights, describing their painstaking laboratory work and its embodiment in their airplanes, he would be deserving of credit similar to that which the aeronautical profession will give Mr. Kelly for his well-written, interesting, and historically accurate story of one of the great achievements of scientific development. Harcourt, Brace and Company, New York, 1943; 340 pages, $3.50.

Principles of Flying

Chapters

The Airplane and Its Parts
Wings and Control Surfaces
Seaplane Floats and Hulls
Cockpit Installations
The Air
Air in Motion
The Forces on the Wing
Factors Affecting Lift and Drag
More About Stalls and Spins
Forces on the Airplane in Flight
The Mechanics of the Glide
Airplane Controls
Principles Involved in the Take-Off
Climbing Flight and Turning Flight
Stability
Lateral and Directional Stability
Propellers
Performance
Practical Flight Considerations
Materials of Construction
Strength Considerations
Types of Fastening
Types of Construction

This text is one of the "Flight Preparation Training Series" published under the supervision of the Training Division, Bureau of Aeronautics, U.S. Navy. Written for student pilots, it is a comprehensive introduction to the fundamentals of flying. It not only presents a study of the principles of aerodynamics and the rudiments of airplane construction but also considers the effects of flight from the physiologic and psychologic aspects. The language used is nontechnical. An elementary knowledge of mathematics and physics is presupposed.

Classified under three main headings of Nomenclature, Theory of Flight, and Structures, the chapters of the book are recommended by the authors as separate teaching units for 45-min. periods. Supplementary slide and strip films are suggested for classroom use. The book also includes a glossary. McGraw-Hill Book Company, Inc., New York, 1943; 337 pages, $1.50.

Aircraft Mathematics

By S. A. Walling
& J. C. Hill $1.75

has been especially written to give a quick review of the mathematics needed in flying. It has been TESTED IN ACTUAL USE BY MORE THAN EIGHTY THOUSAND MEN with the R.A.F., the Canadian Air Force, and men going into the United States Army and Navy Air Services.

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It has 590 problems with answers given for self-checking. No other book available has such a wealth of practical material. Problems are included on fuel consumption, atmospheric pressure, relative speed, the circle of visibility, the weight-power ratio, and many other aeronautical problems.

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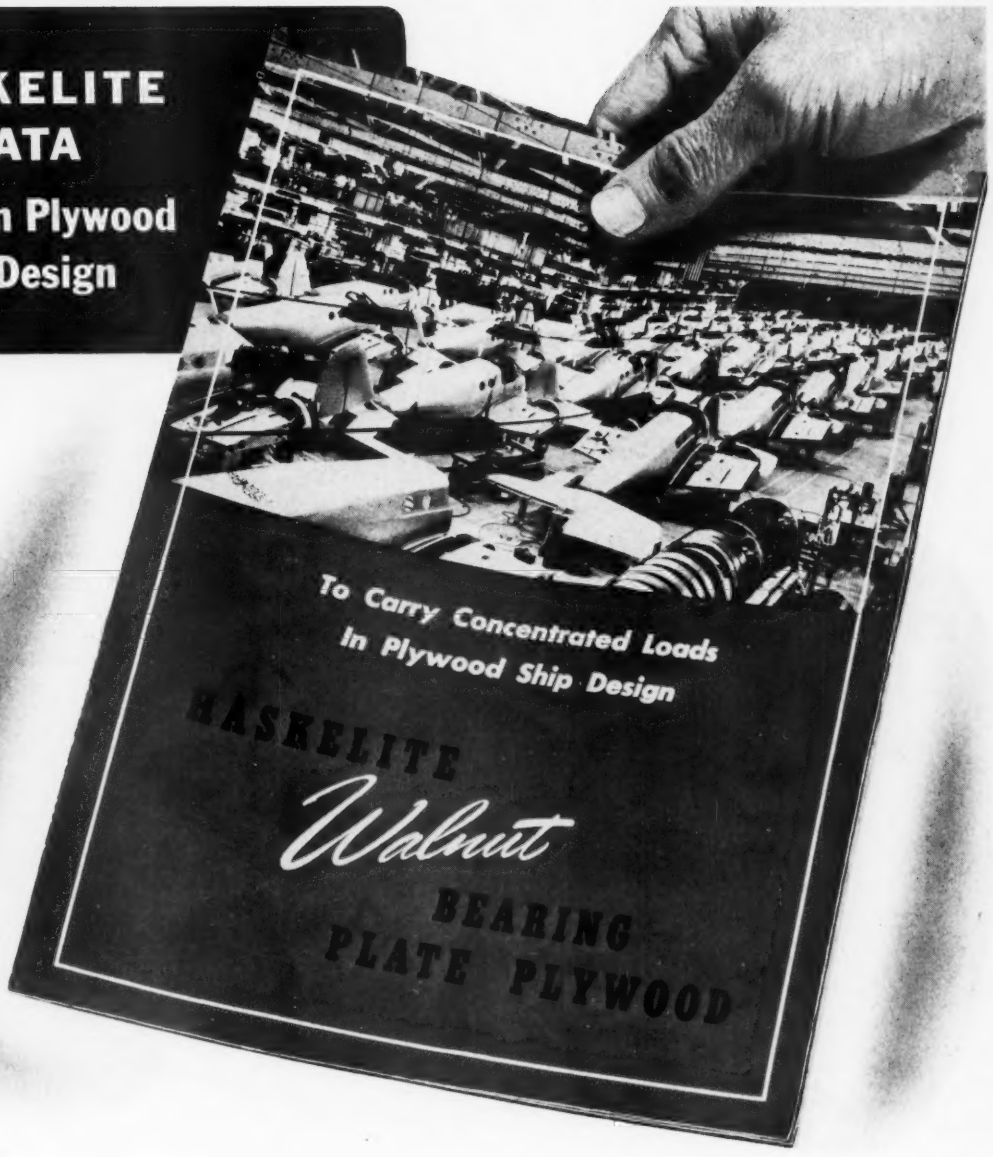

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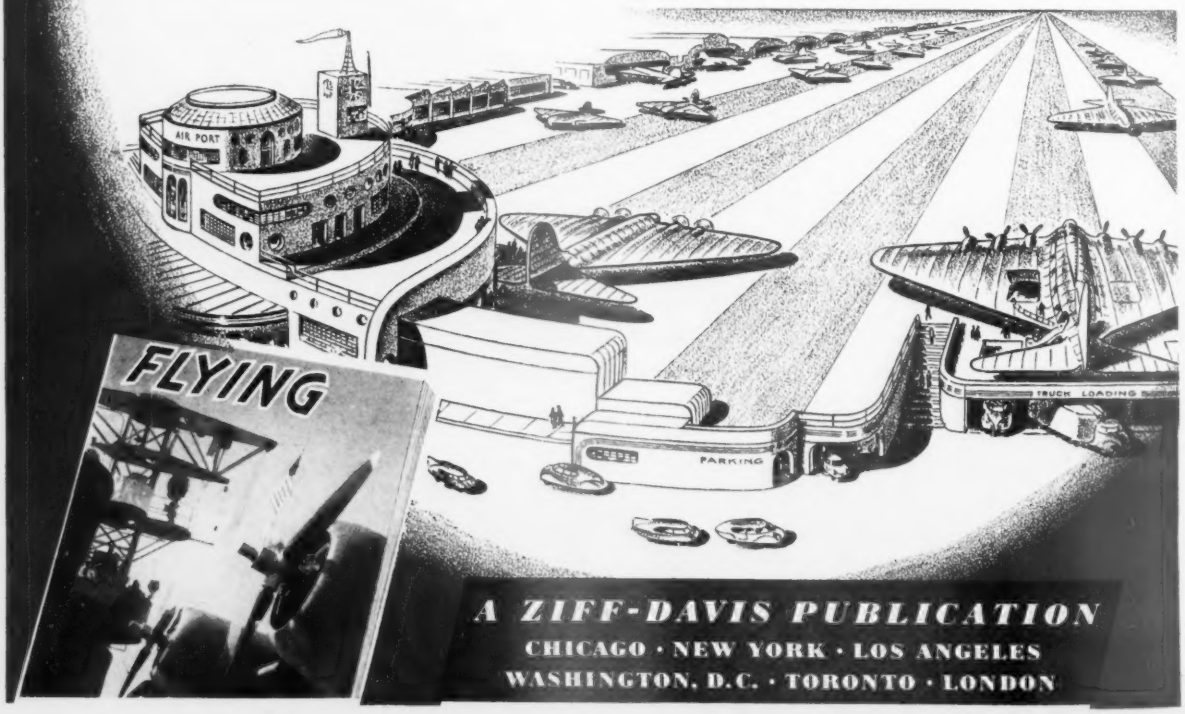

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Fundamentals of Stress Analysis, Volume I

Albert Deyarmond and Albert Arslan

Chapters

Types of Structure
Stress and Strain
Forces and Couples, Laws of Statics, Reactions
Structures with Axial Loads in Members
Beams
Torsion
Section Properties
Allowable Stresses
Design of Axially Loaded Members
Design of Beams
Design of Torsion Members
Design of Fittings and Connections
Design of Beam-Columns
Statically Indeterminate Structures

Based on a course of study taught by the authors under the National Defense Training Program, this volume will be followed by a second covering the design of aircraft members. The course is intended for students who are already familiar with elementary drafting and blueprint reading. In the introductory chapter, structural design procedure and basic principles are discussed. Types of structures, such as columns, beams and trusses are defined and fundamental information on stresses and strains is given. The remainder of the book deals with forces and couples, structures with axial loads in the members, beams, torsion, section properties, and allowable stresses. There is an appendix, containing a large amount of information in the form of tables and graphs, and also a glossary. Aero Publishers, Glendale, Calif., 1942; 256 pages, $3.00.

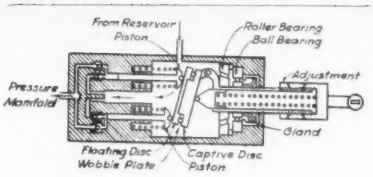
Airplane Hydraulic Systems

Hugh C. Aument, Jr.

Chapters

Basic Hydraulic Principles and Fluids
Reservoirs
Check Valves
Relief Valves
Hand Pumps and Power Pumps
Surge Chambers, Pressure Tanks, and Accumulators
Selector Valves
Actuating Units
Pressure Regulator
Lines, Tubing, Seals and Glands
Comparison of Hydraulic Systems
Filters for Aircraft Hydraulic Systems
Sperry Exactor Control
Hydraulic Systems
Inspection and Maintenance

The text of this book is devoted to hydraulics as used in aircraft equipment. The author explains the operation of airplane hydraulic equipment so that the mechanic who must work with it will understand the operation



Variable displacement, constant pressure power pump. (See *Airplane Hydraulic Systems.*)

of the essential units and therefore be able to carry out service work more efficiently. There has been considerable literature published on aircraft hydraulic systems, but this book is claimed to be distinctive in that the author has presented the subject in a simplified form, giving information the mechanic must have but eliminating that which will be of little practical value to him.

The book has been written in this way because the author has found from his personal experience as an engineering student, practical mechanic, and instructor that this streamlined method of presentation produces the best results in the shortest period of time. The illustrations are not engineering drawings but are of the schematic type designed to show the operation of the actual units. In some cases lines and parts have been omitted to simplify the explanation of the basic units and systems. The Ronald Press Company, New York, 1943; 120 pages, $2.25.

Metalwork Technology and Practice

Oswald A. Ludwig

Chapters

Planning the Job
Bench Work and Power Saw
Getting Acquainted with Metals
Care of Equipment
Drill Press Work
Threads, Dies, Taps
Fitting and Assembling
Work with Sheet Metal
Heating Metal
Tool Sharpening
Finishing and Inspecting
Machine Tools

Basic information for those engaged in the metalworking trades and allied industries is given in this manual. The course is intended for use in classes covering shop theory, technology, technical information, and shop science. Tools, materials, and operations that are common to many metalworking occupations are described. These occupations include machine-shop trades, automotive and aeronautical work, metal patternmaking, foundry work, sheet metal trades, metal building trades, ornamental metal work, and electrical trades, all of which are dependent on this information.

Because training values are the result of gaining knowledge as well as working things, the author has avoided overemphasizing the skill aspects of the subject. Special attention is given to important trade and technical terms. Since it is particularly necessary for the student to learn all new words, these are italicized.

While written as a textbook for regular study and reading assignments, the manual may be used for reference purposes. The teacher may use this book as a guide in planning his demonstration and the student may use it to prepare for the demonstration in order that he may observe it more intelligently. The table of contents may be used by the teacher as a course outline. Each of the twelve parts of the course is divided into units, and each unit is arranged on the unit instruction sheet plan. Insofar as it is possible, the units have been arranged in the order of learning difficulty. McKnight & McKnight, Bloomington, Ill., 1943; 397 pages, $4.00.

Aircraft Production Planning and Control

H. D. MacKinnon, Jr.

Chapters

Production and the Work Order System
Production Manager
Scheduling Department
Material Control Department
Engineering Department
Tool Design Department
Production Planning Department
Production Control Department
Traffic Department
Shop Departments
Outside Production Department
Scheduling Department
Material Control Department
Production Planning Department
Production Control Department
Traffic Department
Outside Production Department

Procedures for the planning and control of aircraft production in aviation manufacturing plants are described in a book intended to inform those employed in manufacturing groups and also to establish the importance of production planning and production control departments. Because the book is written for the purpose of improving the coordination between the shop and the production department and for instructing those who may wish to enter a production department of the aircraft industry, the duties of other departments of the organization are briefly explained. To enlighten those not engaged in aircraft work, the various procedures and functions of aircraft production are outlined. Pitman Publishing Corporation, New York, 1943; 253 pages, $3.75.

Dictionary of Science and Technology

Maxim Newmark

Contents

Abbreviations
English Terms and Foreign Equivalents
United States and British Technical Abbreviations
Conversion Tables
Formulas for Conversion of Temperature Scales
Technical Abbreviations in French
Index of French Terms
Technical Abbreviations in German
Index of German Terms
Technical Abbreviations in Spanish
Index of Spanish Terms

This dictionary contains 10,000 current terms in the English language most frequently used in the physical sciences and their applied fields, together with separate indexes in French German, and Spanish, conversion tables, and technical abbreviations. It was complied with the object of covering all the subjects of a polytechnical curriculum, and the fields of aeronautics and radio are given particular attention. The differences between American and British usage are covered in the cross references, and the differences between the American and British standards of weights and measures are noted in the conversion tables. The Philosophical Library, Inc., New York, 1943; 368 pages, $6.00.

Aircraft Electrical and Ignition Systems

G. B. Manly

Chapters

Electricity
The Aircraft Storage Battery
Current Generation
Generator Control and Regulation of Output
Generator and Control Unit Overhaul
Engine Cranking or Starting Apparatus
Ignition Systems
Ignition System Timing, Adjustment, and Overhaul
Spark Plugs

An instruction and reference book on aircraft electrical and ignition systems has been prepared for those who wish to learn the practical methods of servicing and overhauling electrical equipment as carried out on aircraft power plants in actual use. The author, a former U. S. Army pilot, has been identified with automotive and aircraft maintenance work and instruction activities for many years. Following an outline of the fundamentals of electricity, the generation and control of current are described and the operation and servicing of storage batteries are discussed. Vibrating and variable resistance regulators are given in another section. The servicing, adjusting and overhauling of generators, control units, and electric systems are other subjects covered. One section of the book is devoted to magneto servicing and overhaul. To make intelligent performance of repair work easier, a description of the construction and function of certain units is provided. Frederick J. Drake & Company, Chicago, 1942; 280 pages, $2.00.

Coastal Command

Chapters

"It's the 'Bismarck'!"
Plot of Operations
The Men and the Aircraft
Flying Start: September 1939
The Fight for Norway
Heinkel-haunted Skies: the Attack in the West
Seeking the Raider in his Lair
Ten Million Miles of Sea
Ocean Rendezvous
The Attack on the U-Boats
The Big Bad Wulf
Rescue Flights and Secret Missions
Blockade by Mine and Bomb
Torpedoes Running Strongly
Their Spirit is Serene

Finding the enemy, striking the enemy, and protecting British ships is the triple task of Britain's Coastal Command and this book gives the Air Ministry's account of the part played by the Coastal Command in the sea battles of this war. It describes the operations and record that have resulted from the coordination of Britain's Royal Navy with her Royal Air Force, tracing the history of the Coastal Command from its test mobilization two weeks before the outbreak of war to its current development.

The varied activities of the Command are outlined; its protection of convoys and its relentless fight against enemy shipping are dramatically highlighted. Among the stories told are those of the sinking of "Bismarck," missions in Norwegian fjords and along the coast of France, rescues, and antisubmarine activities. One hundred and twenty-five photographs illustrate the text. The Macmillan Company, New York, 1943; 143 pages, $1.50.

Stereopix

William H. Barton, Jr.

Chapters

The First Point of Aries
Time
Sky Clocks and Calendars
The Equator and the Horizon
Noonsight for Latitude
Circles of Equal Altitude
More Circles of Equal Altitude
Circles of Position
Lines of Position and Fixes
The Z P S Triangle and its Solution
The Earth and the Sky
Great Circle Sailing

To illustrate properly the theory of celestial navigation an understanding of three dimensions is required. A booklet on celestial navigation containing stereo pictures has been compiled as a companion piece to the book titled *An Introduction to Celestial Navigation.* It may also be used with other navigation texts. The success of the method of navigation teaching at the Hayden Planetarium led to the idea of using three-dimensional illustrations for presenting the subject in book form.

The booklet is offered as a means for overcoming the difficulty students experience in picturing the complexities of three-dimensional space by means of a two-dimensional drawing. Each picture is printed in red and green, the two parts corresponding, respectively, to the object as seen by the left eye and as seen by the right. In order to direct an image to only the eye for which it is intended, spectacles having red and green eyepieces are provided with the book. Illustrations show: The Solar System and its Relation to the Zodiac; Sun's Daily and Yearly Motion; Motion of the Northern Sky in 24 Hours; Relation of the Equator and Horizon Systems of Coordinates; Taking the Noonsight for Latitude; Circles of Equal Altitude Around a Flag Pole; Circles of Equal Altitude Around a Point on the Earth; Circles of Position Making a Fix; Lines of Position Making a Fix; The Z P S Triangle on the Celestial Sphere; Terrestrial and Celestial Circles; The Astronomical Triangle Brought Down to the Earth. Wm. H. Barton, Jr., New York, 1943; 26 pages, $1.50.

Solar Relations to Weather

H. H. Clayton

Chapters—Volume I

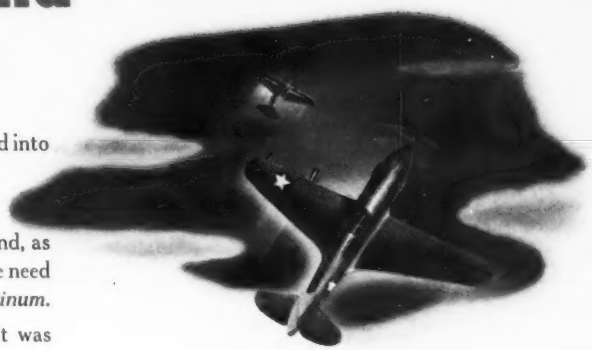
The Yearly and Daily Cycles
Solar Variality and Weather
Solar Cycles and Weather Cycles
Forecasting the Weather
Solar Cycles and Life Cycles
The Hypothesis of the Planetary Cause of Sunspots

Chapters—Volume II

Periodicity in Weather
Weather Waves
Relation of Weather to Solar Changes
Relation of Solar Changes to Electric and Magnetic Changes

In these two volumes on meteorology the author examines the effects of solar changes upon world-wide weather conditions. From his experience as a

Out of the Ground Into the Sky!



This good old American soil is on its way out of the ground into the sky to help win this war.

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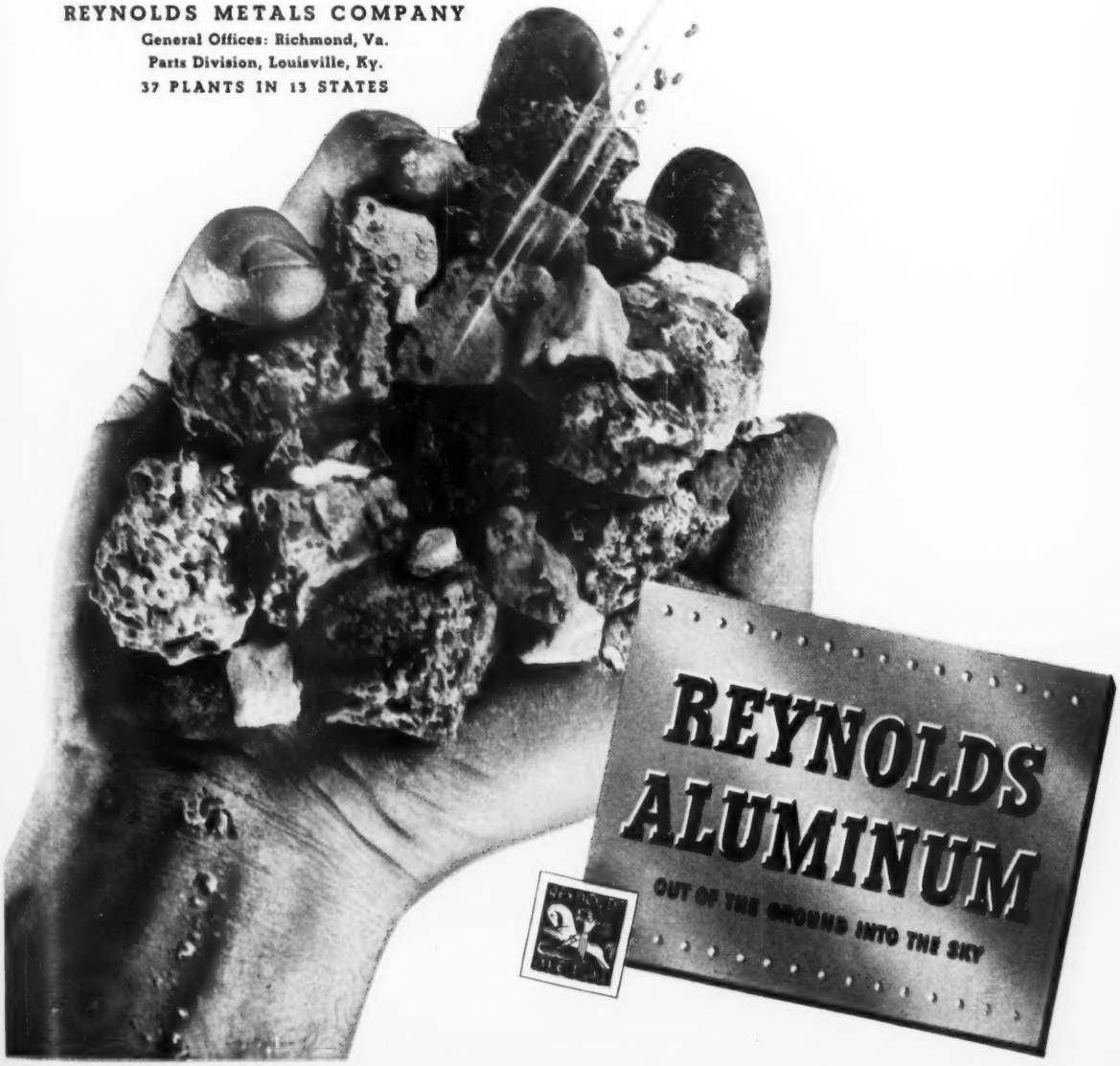

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meteorologist with the Blue Hill Observatory, the U. S. Weather Bureau, the Argentine Weather Service, and the Smithsonian Institution, he observes also the relationship between the sun's variations and magnetic electric and radio conditions. The subject of solar changes is amplified further to include suggestions regarding their influence on human life.

In addition to studying the influence of solar variations on the weather and on the life of plants, animals, and man, Volume I discusses the possible origin of solar variations. The ultimate source of climate and weather is taken to be the sun, and familiar weather changes are traced to variations in the intensity of solar radiation. A supplement deals with the connection between solar activity and the cold waves of the winter of 1942–1943.

Volume II contains reprints of brochures covering researches on which a major portion of Volume I is based. There are 32 papers in all, 29 by the author and three by other writers treating of the same subject. Eight deal with periodicity in weather, two with weather waves, and 15 with the relation of weather to solar changes. Five papers are concerned with the relation of solar changes to electric and magnetic changes in the atmosphere and structure of the weather; one paper, with the question of planets and sunspots; and the last, with the influence of rainfall on commerce and politics. The Clayton Weather Service, Canton, Mass., 1943; Vol. I, 105 pages, $3.00; Vol. II, 439 pages, $3.00.

Operation of Aircraft Engines

Chapters

Basic Principles and Types
Engine Parts
Fuel Systems
Carburetors and Induction Systems
Lubrication Systems
The Ignition System
Aircraft Propellers
Engine Instruments and Controls
General Considerations
Starting and Warming Up
Flight Operation

One of the "Flight Preparation Training Series," this book is intended to familiarize the student pilot with operating principles of aircraft engines. It explains the functioning of an engine to him and helps to teach him how to use most effectively the engines that he may expect to fly. The author covers the subject from a general and primary point of view, eliminating detailed descriptions of engine and accessory construction. Since low-powered engines are those that the aviation cadet encounters first, emphasis is placed upon engines of this type. The book also discusses general considerations, starting and warming up, and flight operations. McGraw-Hill Book Company, Inc., New York, 1943; 202 pages, $0.90.

Books reviewed in this section may be borrowed without charge from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Basic Physics for Pilots and Flight Crews

E. J. Knapp

Chapters

Units of Measure
Vectors and Balanced Forces
Accelerated Motion and Laws of Motion
Fluids at Rest
Work, Energy, Power, and Friction
Fluids in Motion
Heat
Heating of the Atmosphere
Properties of Gases
Change of State
Atmospheric Humidity

This physics primer is designed to meet the requirements of primary flight or air-cadet training. Outlining the fundamentals of physics, the text directs their application to the subjects of meteorology, theory of flight, and engine operation. At the end of each chapter there is a series of questions to test the student on his knowledge of the material covered. Answers to the questions and problems are supplied. Prentice-Hall, Inc., New York, 1943; 118 pages, $1.65.

Shop Mathematics and Shop Theory

John M. Amiss, G. Keith Shurtleff, and Hughitt G. Moltzau

Chapters

Preliminary Mathematical Processes
Logarithms
Mensuration
Geometry
Trigonometry
Application of Shop Mathematics
Blueprint Problems
Safety and Fire Protection
Manufacturing Methods
Gages and Measuring Instruments
Cutting Tools
Composition and Heat Treatment of Cutting Tools
Gearing
Machine Tools
Handbook Projects
Special Subjects
A. Superfinish
B. Oilite Bearings
C. Plastics

Originally written for the Chrysler Corporation, practical methods and actual applications form the basis for this manual on shop problems involving mathematics. It is recommended by the authors for use as a textbook with any of the standard handbooks on shop mathematics and shop theory. Conforming to the needs of shop men—machinists, tool and diemakers, inspectors, draftsmen, and engineers—who must solve problems with extreme accuracy and speed, this book contains the fundamental knowledge necessary for deriving maximum benefit from handbook material. An appendix contains the Engineering Standards used by the Chrysler Corporation. Harper and Brothers, New York, 1943; 360 pages, $1.60.

Ways of the Weather

W. J. Humphreys

Chapters

Weather Perceptions
Weather Measurements
The Atmosphere: Origin and Composition
Structure of the Atmosphere
Distribution of Temperature
Distribution of Water Vapor
Distribution and Changes of Atmospheric Pressure
Wind
Precipitation
Atmospheric Electricity
Weather Music
Atmospheric Optics
Climate, Present and Past
Weather Control
What of It?
Meteorological Mileposts

As is indicated by the title, this book is devoted entirely to meteorology. The author covers the subject in a way that can be easily understood by the nontechnical reader, without neglecting or glossing over its many scientific phases. The first part contains a general description of weather precipitation and measurements. The author then provides a detailed explanation of the origin, composition, and structure of the atmosphere and describes the distribution of temperature, water vapor, and atmospheric pressure. The important part that atmospheric electricity plays in weather phenomena is described. Other subjects discussed in an understandable manner are climate and weather control. Mileposts in the evolution of meteorology are described in a final historic outline of the subject. The Jacques Cattell Press, Lancaster, Pa., 1942; 400 pages, $4.00.

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UNITED AIR LINES

WESTERN AIR LINES

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JACKSON, MICHIGAN
U. S. A.

Western Representative:
AIRSUPPLY CO.
5959 W. THIRD ST.
LOS ANGELES, CALIF.

Eastern Representative:
J. HENRY REISNER
HAGERSTOWN, MARYLAND

Book Notes

Map Interpretation with Military Applications, by William C. Putnam; McGraw-Hill Book Company, Inc., New York, 1943; 37 pages, $1.25.

This atlas provides a background for understanding the significance of the landscape in its relation to military tactical decisions. It explains the topographic expression of rocks and the results accomplished by the more important erosive processes. The first two sections of the book are devoted to a study of terrain features as represented by contour maps and aerial photographs; the third, to geologic interpretation; and the last, to the changes in the surface of the earth through erosions caused by running water, ice, wind, and waves.

The Friendly Arctic, by Vilhjalmur Stefansson; The Macmillan Company, New York, 1943; 812 pages, $5.00.

A revised edition of a book on polar exploration. A new preface, a new index, and a new chapter have been added. In this chapter, the author indicates to what extent the conclusions of his expedition have been supported or revised by newer scientific theories and later explorations.

Front Line; The Macmillan Company, New York, 1943; 160 pages, $1.50.

Issued for the British Information Services, this book deals with the civil defense of Britain. It tells of the organization and techniques that were employed to combat German attacks on civil and industrial centers. Descriptions of the various types of German blitz are included—from preparatory raids for invasion to "nuisance" bombings. Written in documentary style, the text is supplemented by many illustrative photographs.

Bombardier, by Henry B. Lent; The Macmillan Company, New York, 1943; 171 pages, $2.00.

The training of an American bombardier is described in this story of how one boy won his bombardier's wings. The book follows his career from the time he first arrives at the Army Air Base training school until he is ready to launch the bombs from a Liberator in actual combat.

Last Man Off Wake Island, by Lt. Col. Walter L. J. Bayler; The Bobbs-Merrill Company, New York, 1943; 367 pages, $2.75.

The only man who escaped death or capture by the Japanese on Wake Island gives a first-hand account of its defense. He also relates his experiences while fighting on Midway and Guadalcanal. This narrative is reported as it was told to Cecil Carnes.

How to Draw Planes, by Frank A. A. Wootton; The Studio Publications, Inc., New York, 1943; 64 pages, $1.00.

One of a series of books for children giving elementary information on how to draw aircraft. It is a revised edition and illustrations show the changes in later designs of aircraft. The pictures of the forerunners of modern aircraft are retained so that new developments in design can be studied.

PX, by Malcolm Taylor; Houghton Mifflin Company, New York, 1943; 231 pages, $2.00.

This adventure story is supposed to take place in 1969. It is woven around the operations of a secret organization for maintaining world peace. The building of a "superplane" is instrumental in the denouement.

Hardness, by D. Landau; The Nitralloy Corporation, New York, 1943; 105 pages.

The author makes a critical examination of hardness and dynamic hardness and attempts to reduce hardness to dimensional analysis. Much of the work of the French scientist, P. Roudié, which the author believes has served greatly to raise the study of hardness from mere experiment to the basis of a science and whose work apparently has not been widely disseminated to scientific workers in this country, is incorporated in the text. In covering the subject the author has also drawn freely from a recently published collection of writings on hardness by Prof. Samuel R. Williams.

Following a brief survey of the machines and methods, past and present, employed to determine hardness, the definition of hardness is discussed. Dynamic hardness then is considered and Roudié's study of the subject is reviewed. A definition for dynamic hardness, the units for a standard of dynamic hardness, and the hardness of nonmetals are discussed. Hardness testing and the types of machines used for these tests are other subjects covered.

What You Should Know About the Army, by Harvey S. Ford; W. W. Norton & Company, Inc., New York, 1943; 259 pages, $2.50.

With a new title, this is the second edition of a book formerly called *What the Citizen Should Know About the Army,* describing the fundamental reorganization that has taken place in the Army Ground Forces, the Army Air Forces, and the Army Service Forces. It presents the latest available information on the U.S. Army as it is today. The author describes the Army's organization, the duties of enlisted men and officers, the various so-called arms and services, the function of the General Staff, and how modern war is conducted.

Pilot Judy, by Cynthia Mulburn; Gramercy Publishing Company, New York, 1943; 255 pages, $2.00.

This is a story built around the experiences of the first woman flight instructor at a fictitious army flying field. It tells how she was accepted by the young cadets in training and portrays her adventures.

South from Corregidor, by Lt. Comdr. John Morrill; Simon and Schuster, New York, 1943; 252 pages, $2.50.

This personal account records both the fall of Corregidor and the escape of 18 men of the Navy mine sweeper, "Quail," from the Philippines. Traveling for 31 days through waters infested by the Japanese, through courage and perserverance these men managed to reach Australia in a 36-ft. boat. A section of this book has appeared in *The Saturday Evening Post* under the title of "Eighteen Men and a Boat."

Willow Run, by Glendon Swarthout; Thomas Y. Crowell Company, New York, 1943; 237 pages, $2.50.

The Willow Run bomber plant furnishes the background for this novel. From the author's experiences as a riveter at Willow Run, he tells of the heterogenous types of people who build bombers, how they live, and how they work.

Sunward I've Climbed, by Hermann Hagedorn; The Macmillan Company, New York, 1943; 166 pages, $1.75.

A biography of John Magee, young aviator-poet killed in this war. The author gives a comprehensible picture of the personality, character, and talent that fathered the acclaimed poem "High Flight." He is also concerned with interpreting the gallant reactions of youth to the emergencies of war.

The Mermaid and the Messerschmitt; by Rulka Langer; Roy Slavonic Publications, New York, 1942; 372 pages, $2.75.

This is the story of a Polish family who lived through the siege, invasion, and surrender of Warsaw. The author, called "the Polish Mrs. Miniver," who has since joined her husband in America, describes vividly the experiences and reactions of an average human being during a Blitzkrieg. The "Mermaid" represents Warsaw, known as the "City of the Mermaid."

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This lending library service makes available, *without charge*, the latest and more important aeronautical books.

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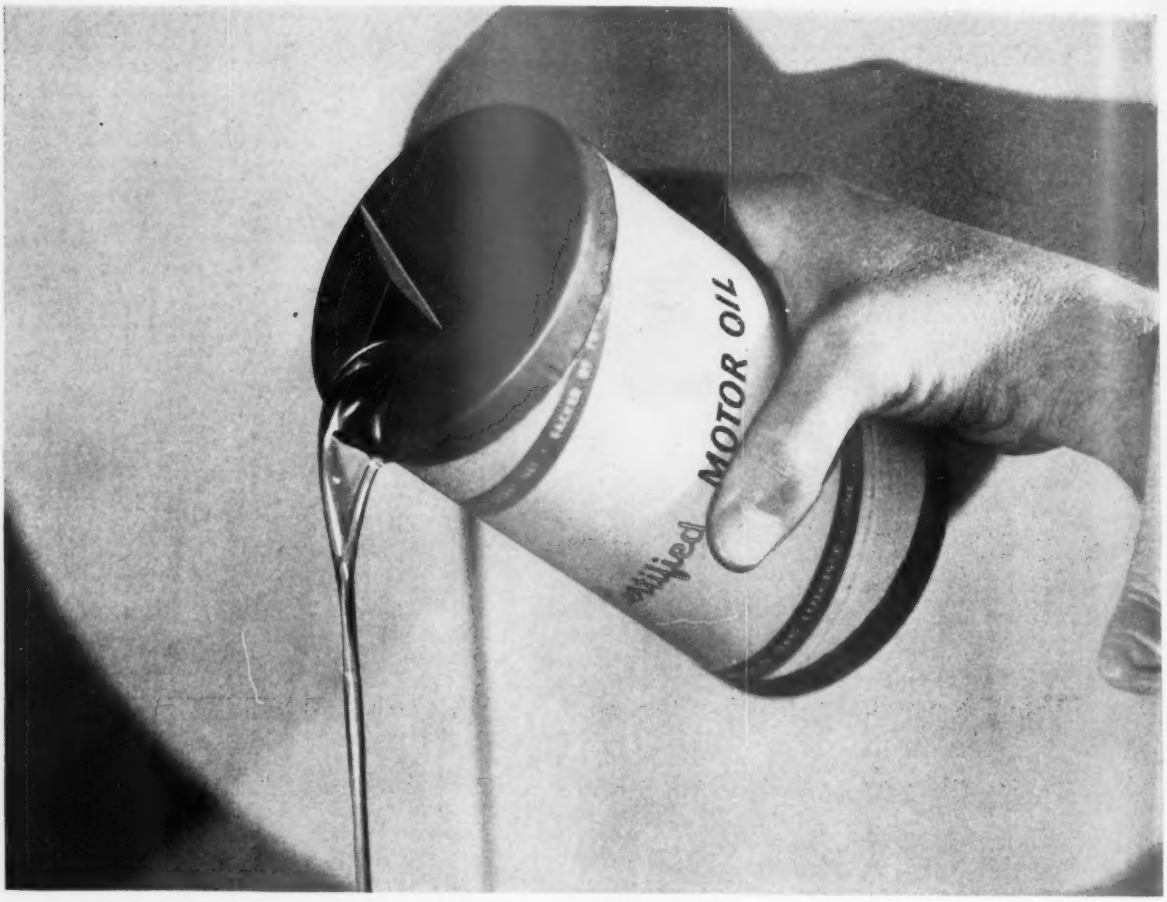

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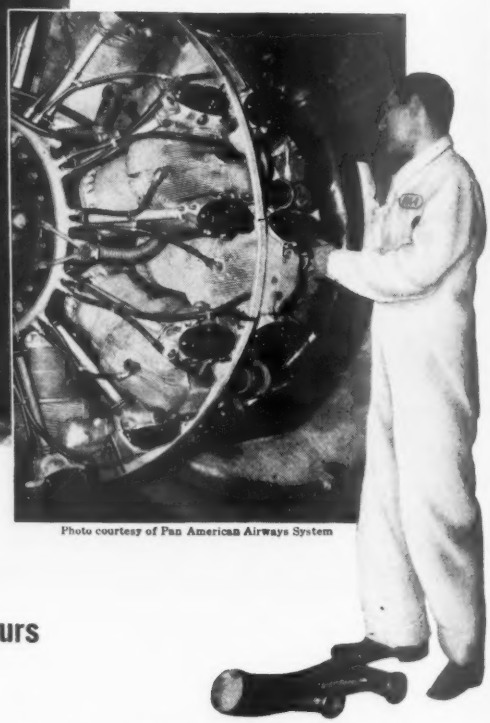

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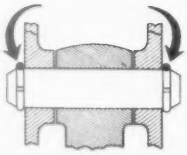

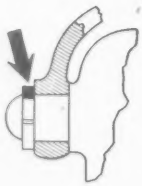

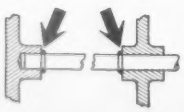

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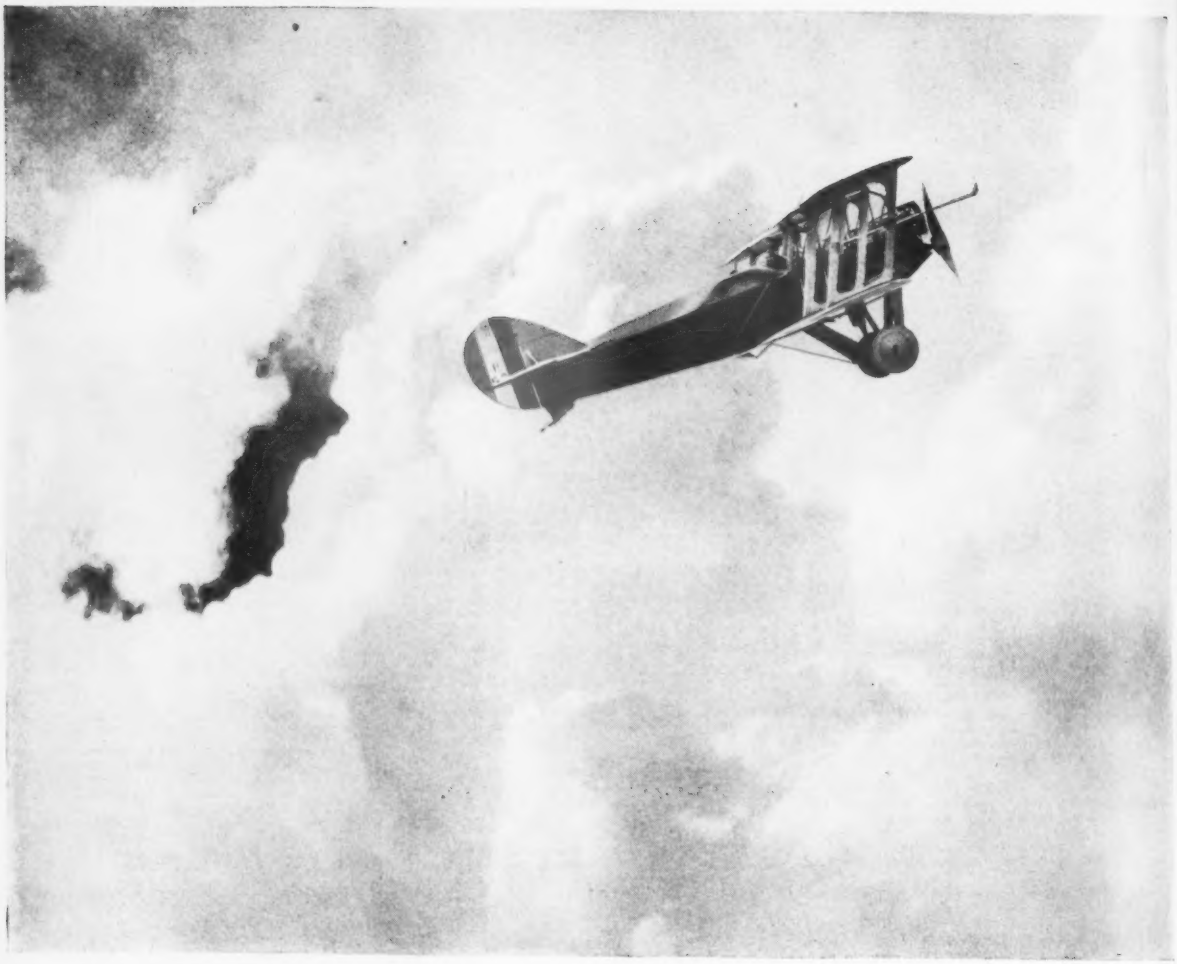

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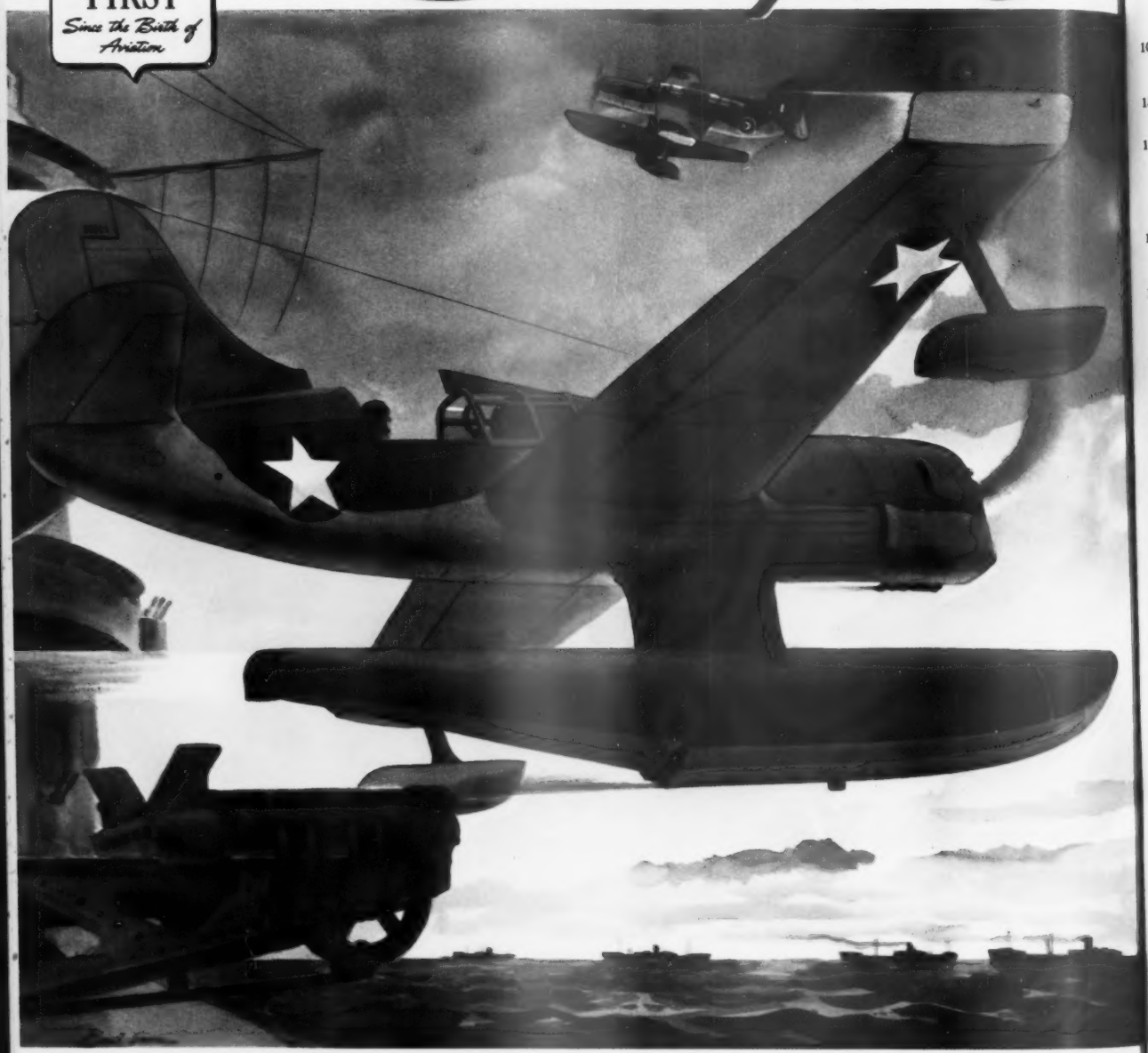

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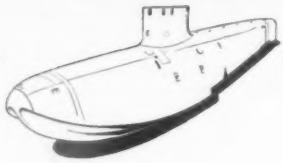

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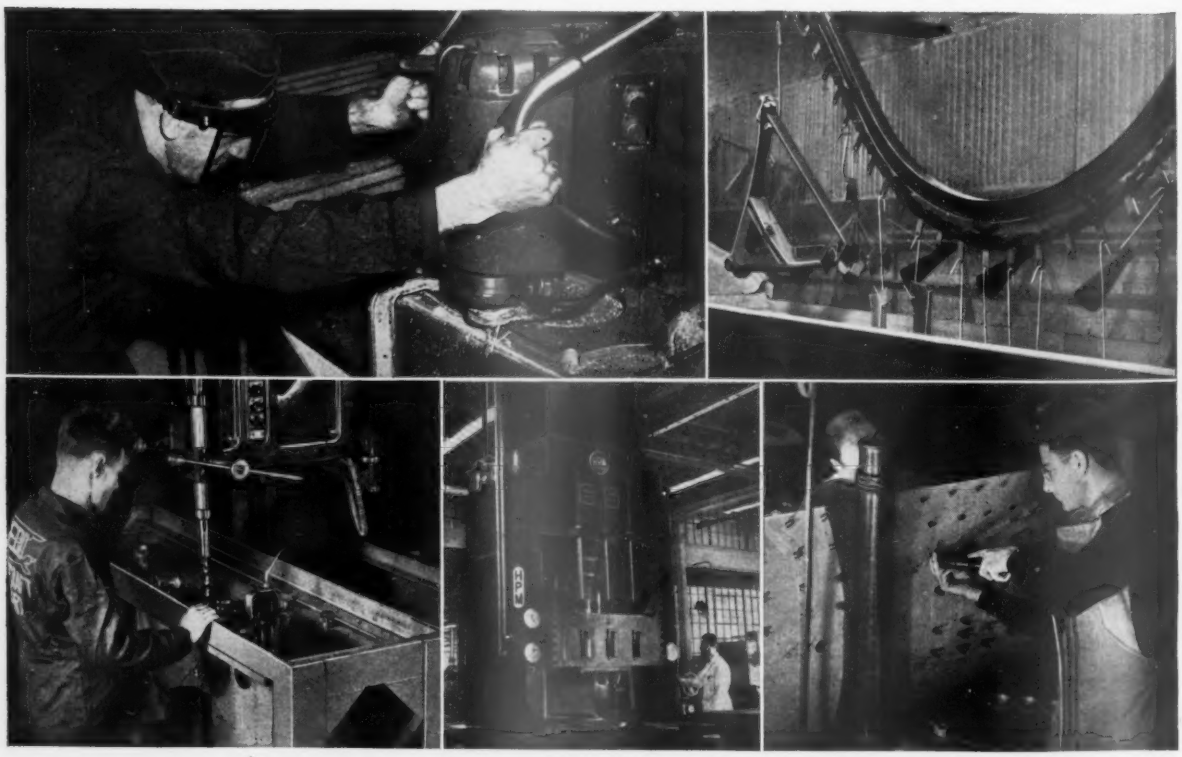

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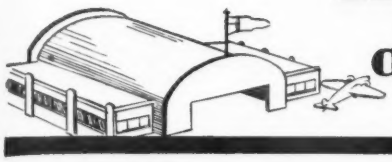

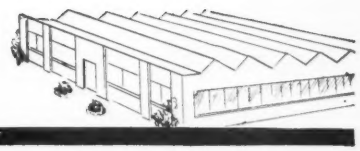

Aerodynamics for the Layman

What Makes it Fly? Charles Sacton. An elementary explanation of the theory of aerodynamics. The purpose of the wing and the factor of wing loading in airplane design receive major attention in the discussion. *Douglas Airview*, April.

Inspection Department

Magnetic Inspection. Robert A. Mitchell. The value and significance of magnetic inspection are given in an article describing the work of Lockheed's magnetic inspection department. Notes on the organization of the department, the training of its personnel, and the equipment in use are included. It is also explained how magnetism results from the application of two principles—the power of a magnetic field to attract ferrous metals and the polarity that occurs on either side of a separation incurred in a piece of ferrous metal —and how this method produces an economy of inspection time and money. *The Lockheed-Vega Aircraftsman*, April.

Data File

A data file on aircraft cable, controls, fittings, and slings is available from the Automotive and Aircraft Division of the American Chain & Cable Company. Four pamphlets supplement the closed-container type file. The descriptive matter of one pamphlet refers to Tru-Loc Ball Type Swaged Fittings, that of another to Tru-Loc "Quickies" for aircraft controls.

The third is a booklet on swaging with rotary machines. It advises on efficient equipment and correct methods of rotary swaging. It also tells how to set up and maintain the swagers, as well as how to avoid defective swaging.

The fourth booklet is on cables and cable terminals for aircraft. In it, information is given on the company's tinned aircraft cable and strand, Korodless Aircraft Cable and Strand, control assemblies, hoisting slings, Tru-Loc Swaged Type Terminals, standard and special fittings for aircraft cables. Other products covered are: thimbles, serving or seizing wire; safety wire; mooring pendants, anchor cables, and towing cables; and push-pull controls. *Automotive & Aircraft Division of the American Chain & Cable Company, Inc.*, Bridgeport, Conn.

Industrial Catalogue

The Lombard Governor Corporation, manufacturers of milling machines and inspection and general Navy equipment, has recently published a 68-page book in three colors, *A Report To The Nation*, showing its plant, its products, and its methods of machining. One section covers the history of the plant, background of the business, and future prospects. Another section of the book is devoted to pictures of the plant, methods of manufacturing, personnel, and some of the products. *Lombard Governor Corporation*, Ashland, Mass.

Auto-Lite Aviation Products

A loose-leaf catalogue illustrates the equipment being produced by The Electric Auto-Lite Company for the United States Air Forces and for the aviation industry. The photographs, drawings, and information cover aluminum die castings, batteries, booster coils, current relays, pressure gauges, engine gauge units, generators, and leather products. Metal decorating, plastics, gun-firing solenoids, deep-drawn stampings, thermometers, wire and cable are also described. *The Electric Auto-Lite Company*, Toledo, O.

Control System for Parts in Fabrication

It's in the Cards. A dispatch board system for locating parts and showing their progress through various shops is described. Used at the Boeing Wichita plant, this system is said to effect a great saving in time. *Boeing Contact*, April.

Training Propeller Service Men

Westerly School Graduates 25th Army-Navy Class. The training program in effect at the Westerly Service School of Hamilton Standard Propellers is outlined. The school's purpose is to train military personnel in the servicing and maintenance of propellers on the battle fronts. Although the majority of students are United States Army Air Force mechanics, the program is also available to United States Navy personnel, civilian mechanics, civil service men, and Hamilton Standard service representatives. The course includes training in propeller assembly, disassembly, repair, balancing, oil test, governor maintenance, and trouble shooting. It covers a period of at least 24 days of work and study, six of which are devoted to governors, six to blade repair, and twelve to propeller overhaul. *The Bee-Hive*, February-March.

Portable Weighing Wagon

Mahomet Goes to the Mountain. Particulars on a Fleetwings innovation for weighing the many small parts which form the wing or rudder are given. To effect an economy of time, a mobile weight unit was devised. This can be wheeled to the parts and weighs them on the spot, thus eliminating the necessity for transporting the parts to a central weighing station and back. *The Fleetwings' Arrow*, April.

Welding Bench

Something New in Welding? An improved gas welding bench, in use at Fleetwings, is described. The bench is lined on top with a smooth surface of fire brick resting above a $^3/_{16}$-in. steel plate. It includes a surface of $^3/_8$-in. steel metal plate, heavy enough for hammering and straightening of work; a welding wire holder; and an automatic shut-off valve. *The Fleetwings' Arrow*, April.

Pilot Training

Primary Training—1917 and Now. Verne E. Treat. The writer describes ground-school and primary flight instruction during the first World War and compares them with modern training methods. He also comments on differences between the training planes and engines formerly used and the present-day Fairchild PT-19 airplane and Ranger engine. His conclusion is that there has been a great change in equipment since the last war but very little change in training technique. *The Pegasus*, May.

Process for Molded Plywood

Molded Plastic Plywood. The Langley Process for the manufacture of airplanes, gliders, and parts from molded plastic plywood is described in an illustrated booklet. Facilities of the de-

veloper and the licensed manufacturers are given, as well as the methods used in the production of aircraft by that process. Tests to which aircraft parts are subjected are shown. A review of the organization and personnel of the company is included. *Langley Aviation Corporation*, New York, N.Y.

Lathe Catalogue

Catalogue No. 100-C describes the entire line of South Bend engine lathes, toolroom lathes, and turret lathes. The engine lathes are made in five sizes ranging from 9- to 16-in. swings. The toolroom lathes are available with swings from 10 to 16 in., and the turret lathes are made in two sizes: 9- and 10-in. swings.

This catalogue contains 48 pages. Each size and type of lathe is illustrated and described. Specifications are tabulated to facilitate the selection of the lathe required for any desired application. Attachments and accessories for adapting these lathes to special classes of work are also illustrated and described. *South Bend Lathe Works.*

Up to Standard

An Airplane is Born. Palmer Wentworth. Part IX. A continuation of a series of articles outlining each step in the manufacture of an airplane. This installment deals with the Inspection Department and tells how everything produced by the Ryan Aeronautical Company is checked to conform with the rigid standards set by the Army and Navy as well as those of the company itself. A typical steel casting is followed through its various inspections from the time a shipment of rough castings is received from the foundry until the casting becomes part of a completed airplane. *Ryan Flying Reporter*, April 16.

Plant Expansion

The Ohio Plant—Today. A description of the rapid expansion of the Wright Aeronautical Corporation's Ohio plant. It is explained that this plant, which was started in 1940, has now become a major source for aircraft engines. Cyclone engines of the double-row type are being produced for such planes as the North American B-25, the Douglas A-20, the Grumman Avenger, and the Martin Mariner. Thirty months of planning, constructing, and inventing have brought the plant to its present production output. Among the subjects discussed are the conveyer assembly line for aircraft engines, the use of fluorescent lighting in the plant, foundry methods for reclaiming mold and core sand, the Greenlee transfer machine which performs 71 operations on Cyclone engine cylinders formerly done by 39 separate machines, and production units worked exclusively by women. *Trade Winds*, April.

Synthetic Rubber

In a booklet called *The Five Commercial Types of Synthetic Rubber* the United States Rubber Company relates the history of substitute rubber and the properties of the commercial synthetic rubbers and describes the role played by the company in the development, manufacture, and use of these products. In addition to examining the characteristics and applications of Buna-S, Buna-N, Neoprene, Butyl, and Thiokol, the booklet compares the physical and chemical properties of natural rubber and of the five types of synthetic rubber. Photographs, diagrams, and charts are included. *United States Rubber Company*, New York, N.Y.

Air Map

A map of Canada showing air routes has been issued by the Canadian Pacific Air Lines. Scaled 125 miles to 1 in., the map indicates the routes of Cana-

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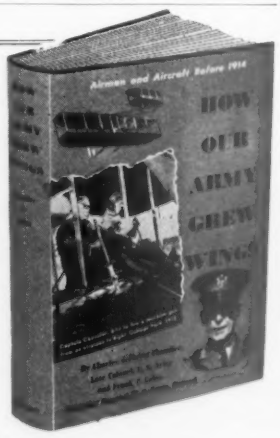

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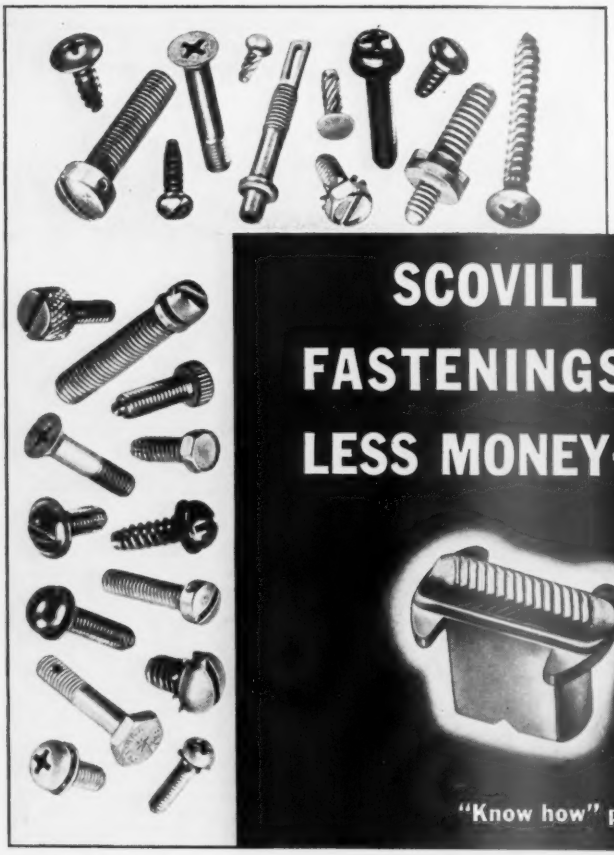

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Measuring and Control Instruments

A condensed listing of the principal items of equipment manufactured by the Wheelco Company is contained in a 16-page illustrated booklet. Prices, specifications, and descriptive data are given on temperature control instruments, portable potentiometers, radiation heads, thermocouples and lead wire, Flame-otrols, and Flame-otrol Auxiliaries. *Wheelco Instruments Company*, Chicago, Ill.

Research and Testing Department

Airplanes from Test Tubes. The functions of North American Aviation's Research Engineering Department are outlined. With the department's activities divided into two sections, one part is performed by the process engineering division and the other by the laboratory. The duties of the process engineer's section are designated as: preparing and specifying the processing procedures and material used by other plant departments, developing new processes and heat-treating procedures; checking the effectiveness of current heat-treating procedures and processing solutions; checking welding methods and lubricants. The work of the laboratory section—carried out by separate groups specializing in chemical, metallurgic, mechanical, and electrical research—includes: testing of materials and examination of possible substitutes; experimenting with new parts, new assembly techniques, and new uses of materials; testing of components for weight, stress, vibration, etc.; determining whether the alloy composition of metals meets specifications and checking their tensile strength, elasticity, and measurements. *North American Skyline*, March-April.

Material for Duramolding

Regarding "Plastic" Planes. Part Three. The third installment of this series on the Duramold process discusses some properties of wood, the fibrous material most commonly used. The basic nature of wood is examined and those of its disadvantages that must be compensated by processing are indicated. The primary adverse characteristic is said to be that of shrinkage.

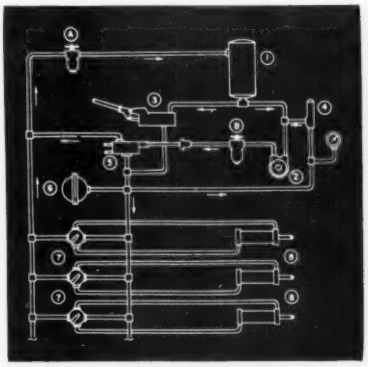
The article also stresses the fallacy of viewing Duramold as a material and not a process. It states that Duramolding differs from other molding and plywood-making processes in methods and processing equipment rather than in the basic material used. *The Pegasus*, May.

Three-Dimensional Seeing

Coat o' Chrome. An account of an experiment in providing more light and better seeing conditions for factory workers by painting machinery. The new two-tone paint coats applied to the maintenance machines of Boeing's Renton Division are claimed to afford: (1) increased production, (2) reduced accident hazards, and (3) improved working conditions. Those parts of the machines which are most likely to be of potential danger to the operators (moving parts, control levers, and immediate working areas) are spotlighted in a light buff color, with the rest of the machine painted in a medium gray, background color. It is stated that the contrast of these two colors plus their high light-reflection qualities enable the operators to see their work in three dimensions. *Boeing News*, April.

Fluid Filters

Information about Cuno filter installations in all major industrial classifications is contained in a 32-page booklet, and 46 case studies are presented. The first part of the booklet is devoted to applications of Cuno fluid filters to aircraft. The principle on which these filters operate is described with the aid of diagrams. Photographs show the various applications of the filter. *The Cuno Engineering Corporation*, Meriden, Conn.



Courtesy Cuno Engineering Corporation

A typical aircraft hydraulic system illustrating suitable filter locations. (1) Reservoir; (2) engine-driven pump; (3) hand pump; (4) relief valve; (5) automatic regulator; (6) accumulator; (7) selector valves; (8) operating devices.

Aviation ABC's

Men to Man Tomorrow's Wings! Myron M. Stearns. A survey of the methods by which the interest of American youth in aviation is being stimulated. The writer tells of the enthusiasm with which the youngsters are responding to "air-conditioning," mentions various organizations which are helping in the aeronautical indoctrination program, and urges further sponsorship of this type of education. Among the methods described are: the incorporation of aeronautical terms and problems into general school subjects such as arithmetic, science, spelling, etc.; educational movies; model-plane building in clubs and schools; and C.A.A. preflight training. *The Rotarian*, April.

Prize Suggestions

Accomplishment Comes with Ideas. Al A. Adams. Six timesaving labor-saving and material-saving devices conceived by Douglas Aircraft employees are announced. The prize-winning ideas produced: (1) a rubber time stamp for recording straight time, overtime, and double time on one card; (2) a new type bracket for simplification of cowl flap valve bracket assembly; (3) facilitation in marking and punching deicer shoes through the use of templates; (4) a universal sharpening attachment for tool-grinding machines; (5) skin improvement for the airplane's nacelle; and (6) an efficient brake poppet valve tester. Photographs illustrate the innovations. *Douglas Airview*, March.

Aeronautical Material Specifications

New and revised specifications have been issued as of April 1, 1943, as an addition to the S.A.E. Aeronautical Material Specifications. Fifteen of these are new specifications and cover the following: preservation of engines; preventive, slushing, and sealing compounds; petroleum solvents; synthetic rubber; paper wrapper; silicon-bronze rods and bars; sheet and strip steel, molybdenum steel; chromium-molybdenum steel plate; and welded steel tubing.

The revised specifications include: corrosion-preventive oil and compounds; copper manganese; magnesium-rolled aluminum alloy; and various grades of nickel-chromium-molybdenum steel. *Society of Automotive Engineers.*

Organization of Engineering Work

Engineering . . . is on a Production Schedule Too! This article describes the organization of the Engineering Division of Bell Aircraft. Designating the various departments that make up this division, it briefly relates the function of each. It also gives an idea of how Bell's Engineering Project System works.

The company's design work is divided among 13 major sections: the Standards, Stress Analysis, Weight, and Aerodynamics groups, and nine design groups each of which specializes in a

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specific component of the plane. A table lists the parts for which each of the following groups is responsible: Power Plant, Landing Gear, Structural (3), Electrical, Flight Controls, Armament, and Fixed Equipment. *The Bellringer*, May.

Aluminum and Magnesium Heat-Treating Furnaces

Bulletin 140 is illustrated with photographs and sketches showing numerous applications of Lindberg furnaces for the heat-treatment of aluminum, magnesium, and their alloys.

The 8-page booklet shows the types available, explains the company's zone control method of heating large loads, illustrates construction features, and lists the range of sizes available in both vertical and box-type furnaces. *Lindberg Engineering Company*, Chicago, Ill.

Idea Awards

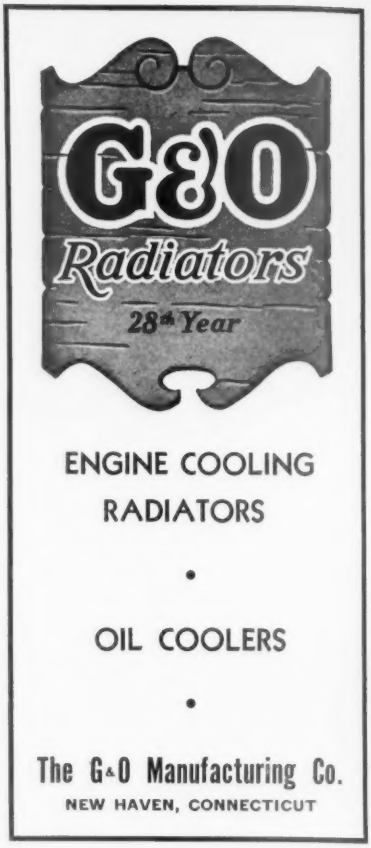
10 Ideas for Victory. Al A. Adams. Ten prize-winning suggestions for improved efficiency are outlined. These were submitted by Douglas Aircraft employees and include suggestions for: an improved method of milling micarta parts; the regulation of air in rivet gun vibrators by the insertion of a pin in the regulator shaft; a safer and more accurate method of holding gas tank ends by means of a jig holding device; an edge distance guide for spot welding machines; a combination drill and holding jig for movable cowl flaps which accurately locates dove-tail strips and holds the strips in place for drilling; a grinding attachment to sharpen teeth of saws; an accident-eliminating pneumatic parts holder for punch presses; and the use of carbon blocks in place of copper on rheostat wiper arm of blueprint machines. Savings in time effected by each innovation are indicated. *Douglas, Airview*, April.

Bulletin on Victory Tool Shanks

A 12-page bulletin gives a description of the maker's line of Victory tool shanks. The first part of the book tells why Meehanite metal is used for these tool shank castings and describes some of the advantages of this material, which has been described as bridging the gap between cast iron and steel. Other paragraphs in this section explain how specially shaped shanks can be obtained. Four pages are devoted to specifications and photographs of straight and bevel-nosed tools. A wide variety of shanks cast in special shapes also are listed. *The Cooper-Bessemer Corporation*, Mount Vernon, O.

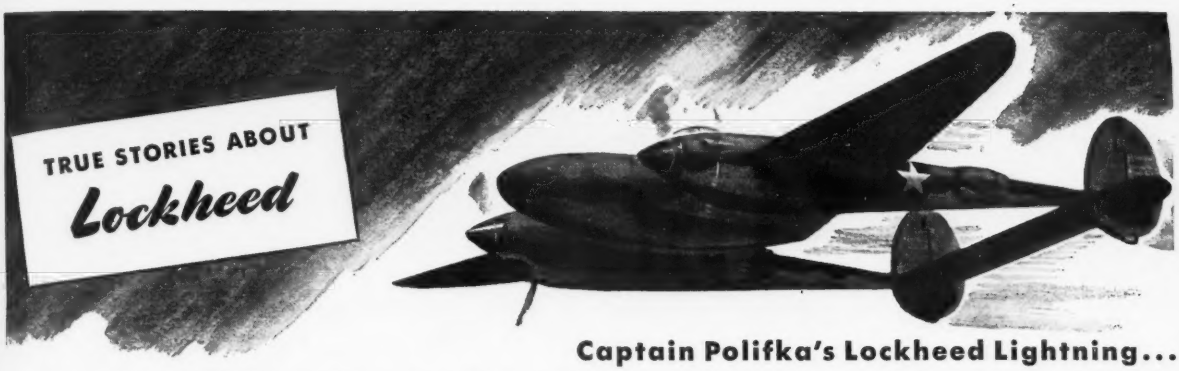
Aluminum-Alloy Development

Might is Light. The story of aluminum production and the development of improved aluminum alloys for aircraft-engine parts and other purposes is told. Problems connected with the extraction of aluminum from the ore are discussed and various extraction processes are described. Difficulties with aluminum include distortion and "pinhole" porosity. It is shown that distortion will cause aluminum cylinder heads to leak, with a resultant loss of water, oil, and engine power. It will also affect the shape of new parts from the shop and make necessary additional machining. How Wright Aeronautical metallurgists working in cooperation with the Aluminum Company of America found a solution to these difficulties in the form of an improved aluminum alloy is described. *Trade Winds*, April.



Properties of Ameripol D

This revised edition of a catalogue section discusses the properties of Ameripol D, an oil- and heat-resisting synthetic rubber for specialized industrial applications, including its resistance to various substances that are the enemies of natural rubber. The following properties are discussed: hardness, tensile strength, elongation, weight, color, odor and taste, elasticity and permanent set, and resistance to tear, abrasion, flexing oils and solvents, and heat. Tables show the properties

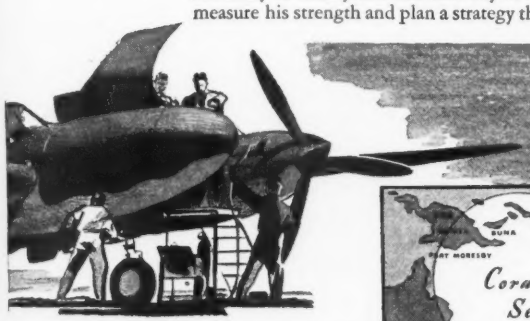


Captain Polifka's Lockheed Lightning...

THE EYES OF THE CORAL SEA BATTLE

Aerial photography has become such an important part of modern warfare that some of our best planes and best pilots have been diverted from actual combat to take the pictures so necessary to victory. It's one sure way to locate the enemy, measure his strength and plan a strategy that will beat him.

Read the exciting story of Captain Polifka and the Lockheed Lightning that became the "eyes of the Coral Sea Battle" and you will understand why the air forces of our Army and Navy can no longer use slow, underpowered planes on important jobs that have a direct bearing on our Freedom.

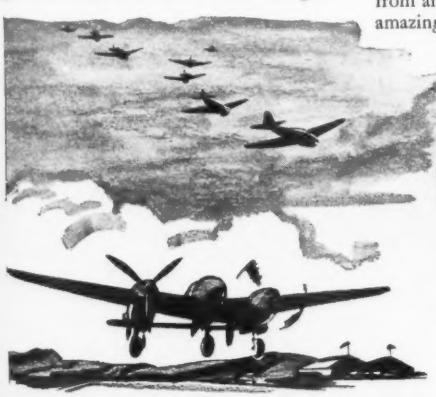


1. Karl Polifka, U. S. Army Captain, was chosen to hunt out the Japs about to attack the U. S. Fleet in the Coral Sea—his duty, to get accurate information on the size and strength of the enemy forces as well as their location. Four powerful aerial cameras were installed in the nose of his Lightning. All guns were removed because of their weight.

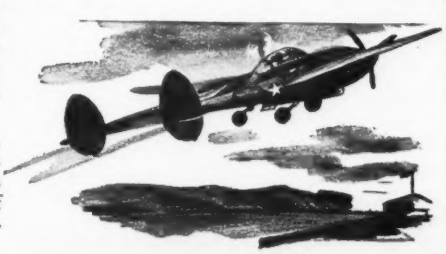
2. The Scene of the Coral Sea Battle is shown on this map. The lighter area within the circle was covered completely by Captain Polifka. Developed prints of this immense region, though taken from an altitude of 25,000 feet, were amazingly accurate to within eight feet.

3. Over the Coral Sea, Captain Polifka took pictures—pictures of land, water and ships that helped us plan victory. All four cameras were syncronized...one shooting forward...one to the back...and one on each side. With one "click" of the four shutters they accurately and simultaneously photographed an area of 2,500 sq. miles.

4. Polifka's Lockheed Lightning proved its superiority over Japanese Zeros during this mission. Over Rabaul, ten of these fast planes took up the chase. Jamming the throttle home, Polifka out-sped, out-climbed them all, and did it with one engine functioning imperfectly.



5. On to Salamaua and Lae sped Polifka to finish his reconnaisance job. Here three more Zeros swooped in to attack. Climbing, diving, hiding in clouds, the Lightning shook them again and on one motor flew to Port Moresby where the pictures were delivered.



6. While he was reporting to Col. "Buzz" Wagner, the flying hero of the Philippines, Japanese planes attacked the airfield. But Polifka, confident of his plane even on one engine—took off in the thick of the raid and flew to the safety of his home base hidden deep in the jungle twenty miles away.

This is one of a series of stories about Lockheed...its men...its accomplishments. Watch the pages of this magazine for another thrilling aviation adventure.

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New wall charts, illustrated in color, give complete sub-assembly parts combinations with AN, AC and manufacturer's parts numbers, for rapid assembly, maintenance or ordering of Aeroquip Hose Lines with Detachable Fittings and Self-Sealing Couplings.

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of the various compounds of Ameripol D, and indicate the services where use of the synthetic rubber is practical. *The B. F. Goodrich Company.*

Oil-Retaining Bronze Bearings

Compo oil-retaining porous bronze bearings are described in an 8-page folder. Eleven advantages of Compo bearings are enumerated and applications of these bearings are listed: airplane bomb racks, controls, engines, gun turrets, instruments and landing gears. Bearings and other parts made from Compo bearing bronze are illustrated. *Bound Brook Oil-Less Bearing Company*, Bound Brook, N.J.

Manufacture of High Octane Fuels

Over the Top in a Test Tube. Crile Cutler. The development of high-octane gasolines for internal combustion engines is traced. The writer explains how improved gasolines have reduced detonation in the cylinder and thus made possible engines of greater efficiency. The cracking process for making fuels of high-octane rating is described and also a process for making iso-octane from refinery gas and blending it with certain chemicals for improved results. The foregoing is given as a prelude to a description of a new process known as alkylation. It is explained that the process involves the use of an alkylate, which is a product of cracking-plant gases combined with iso-butane (distilled from natural gasoline or produced synthetically) in the presence of cold sulfuric acid. Its effect is to shift the molecules of the fuel into new patterns that decrease the tendency to knock. Since alkylation principal raw materials are refinery gases formerly used for refinery fuels and are readily available, the new process makes possible more and cheaper 100-octane gasoline. *Shell Progress*, March-April.

Explosive Rivets

How to Use Du Pont Explosive Rivets for High-Speed Blind Riveting is the title of a new illustrated bulletin issued by the Explosives Department of the du Pont company.

The bulletin contains information on selecting the proper size and type of rivet, preparing rivet holes, handling, storing and expanding the rivets, and use and maintenance of the riveting iron. *E. I. du Pont de Nemours & Company, Inc.*

Tubing Bulletin

Bulletin No. 443, a 12-page booklet on tubing, contains information on tapered and formed tubes and a wide variety of special shapes. It also has a guide chart giving details of the chemical composition of 25 different metals in regular production, together with size range available for each and the mechanical and physical properties. *Summerill Tubing Company*, Bridgeport, Pa.

Dupont explosive rivet, before (*left*) and after (*right*) detonation.

Weight Control Department

These are the People who Measure our Might. The functions of Beechcraft's Weight Control Department are outlined. Operating under the Engineering Division, this department weighs the parts of each model of airplane, recording the weight of each detail part and assembly. In addition to the weight records, it is responsible for the balance of parts, assemblies, and completed airplanes, as well as the compiling of all information into usable forms. *The Beech Log*, April 30.

Service Training

Allison Division is Training Air Force Personnel. This is the third article of a series on Army-Navy training programs that are being conducted by various General Motors divisions. It is explained that the Allison Service School was established by the Allison Division for the original purpose of training United States Air Forces and United States key personnel in the maintenance, operation, and overhaul of Allison liquid-cooled aircraft engines. The scope and activities of the school are outlined. It is stated that the school is the largest training activity of the General Motors divisions both with regard to the number of students trained and to the variety of courses taught. The growth of the school and the training methods and equipment used are described. It is noted that, in addition to the training programs within the United States, Allison has set up three schools in the British Isles. *GM Folks*, April.

Checking the Armament

Gun Tests. Roland Bradley. The work of the armament test men at Boeing Aircraft is described. A specialized group in the engineering division, it is their responsibility to see that the positioning of gun installations affords maximum protection from all angles of attack. They also work out new bomb-release mechanisms, project research in armor plate, and experiment with the most effective placement of armor to safeguard the lives of air crews. *Boeing News*, April.

Bomber Construction

A Bomber is Born. This installment in a series of articles describing the manufacture of a Martin bomber deals with the actual building of the plane. The work of the following departments is mentioned: Metal Detail Division, consisting of the Hammer, Sheet Metal, Metal Bench and Welding, Machine Shop, and Cowling sections; Inspection; Finishing and Plating; Surface and Floats, and Body; and Final Assembly. *The Martin Star*, May.

Planetary Milling Machines

Two new catalogues are available on Plan-O-Mill planetary milling machines. One consists of 14 pages on the No. 3 Plan-O-Mill for cylindric parts up to 8 in. work diameter; the other comprises 18 pages on the No. 5 Plan-O-Mill for larger parts.

Each catalogue is in two colors, with double-spread machine illustrations and tables of features and specifications. The principle of planetary milling is explained and graphically illustrated, together with case histories of form and thread milling in war production. *Plan-O-Mill Corporation*, Hazel Park, Mich.

Wind-Tunnel Details

"Hurricane Hall." A description of the equipment and operation of the North American wind tunnel begins with a brief outline of the painstaking workmanship used in the construction of a scale model of a Mustang fighter constructed of mahogany and metal, weighing 400 lbs., and costing approximately $20,000.

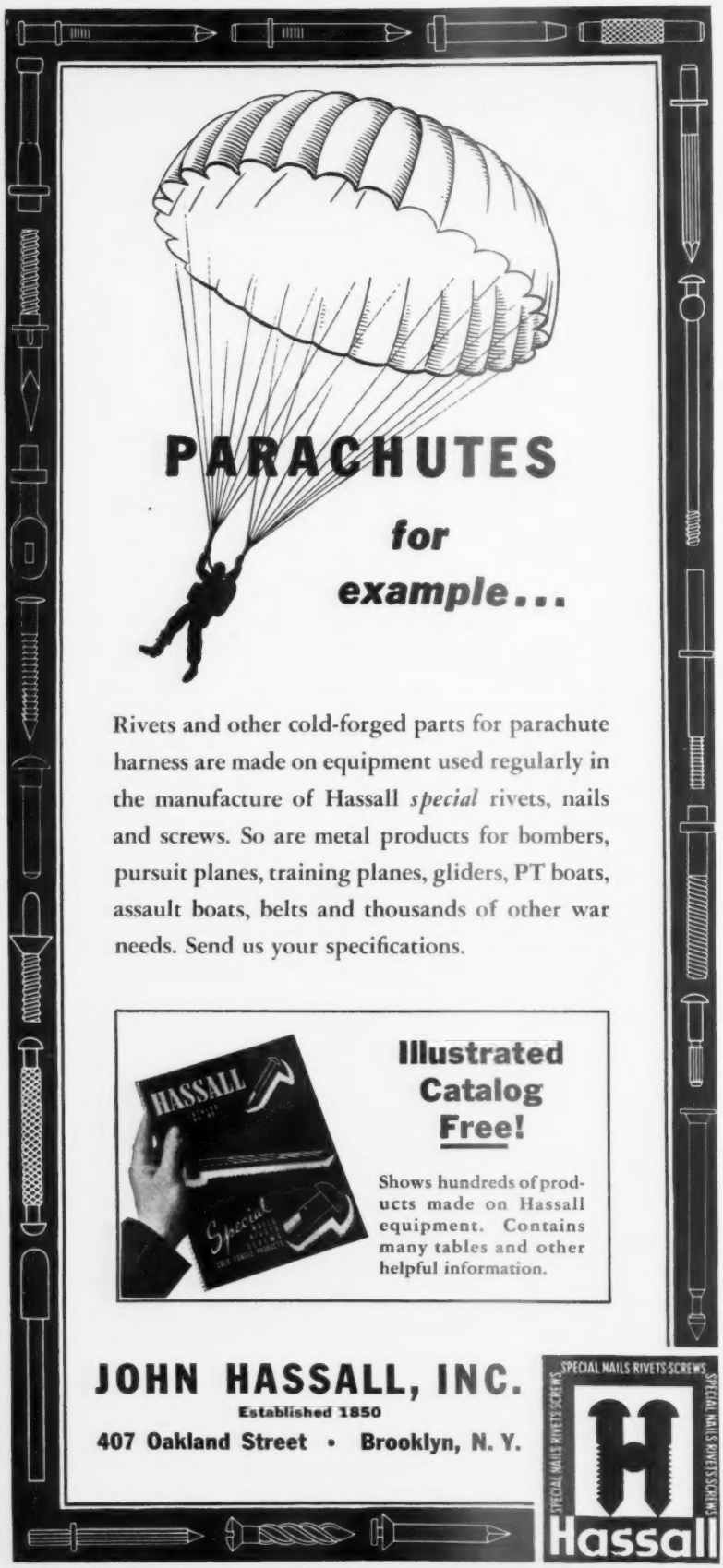
The operation of the wind tunnel, which can produce air speeds up to 325 m.p.h. is traced, with details of the construction of the tunnel and the apparatus for producing the air blast and how technicians record the results and calculate the aerodynamic characteristics of the model. The dimensions of the tunnel are given and the work of its personnel is described. *North American Skyline*, March-April.

National Aircraft Standards

Revised National Aircraft Standard Sheets have been issued as follows: NAS 120, 121, 122, 123, 124, 125, 126, on various types of plastic control knobs.

The following new sheets are also included: NAS 40 on extruded aluminum-alloy half hinges, NAS 41 on continuous hinge pins, and NAS 168 on knurled plastic control knobs of 1-in. diameter.

The Committee has also issued a revised standard sheet covering Brazier head and Phillips recess screws, No. 8-32. This standard, NAS-220, has been changed to indicate a grip length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of 1/32 in. instead of 1/16 in. *National Aircraft Standards Committee*, Washington, D.C.

Aircraft Products Catalogue

A heavy ring binder contains a loose-leaf sectional catalogue covering "Unionair" products for the aircraft industry. The sections at present available show conduit fittings and junction boxes, each section being separated by a suitable tab. The contents include descriptions and illustrations of various departments in the plant of the manufacturer and drawings and tabulated data on the various products covered. Provision is made for the insertion of additional sections as they may be published from time to time. *Union Aircraft Products Corporation*, New York, N.Y.

Extruded Bronze Data

Bulletin No. 111 gives specifications on extruded ANS 4640 bronze. It contains a table of properties of the metal and information on the facilities of this manufacturer. *Ampco Metal, Inc.*, Milwaukee, Wis.

The Corsair

More and More "Corsairs" Roll off the Line to Strengthen Navy's Fighting Force. In addition to presenting information on the design and structural features of the Vought "Corsair," this article reviews some of the production problems entailed in manufacture of this Navy fighter and tells how they were solved. It describes the system of subassemblies, the two "loop" assembly lines that precede the final assembly line, the final assembly line itself, and the series of assembly "stations."

In commenting upon the engineers' approach to the Corsair's design, it is stated, that, with higher speed uppermost in their minds, they first selected the most powerful engine and largest propeller ever used in a fighter and then designed the smallest possible fuselage around it. *The Bee-Hive*, February-March.

Insurance Pocket Manual

A loose-leaf pocket manual has been prepared for the use of insurance representatives and agents covering aircraft insurance matters. It contains definitions of terms as used in aircraft insurance policies, digests of regulations issued by the Civil Aeronautics Authority, insurance rates, and rules concerning the types of coverage that may be written. *Aero Insurance Underwriters*, New York, N.Y.

Industrial Surveys

Information on the subject of women in industries is contained in a booklet designated as Report No. 136 and titled

Not with a flying machine alone can man succeed in completely conquering the air. The vacuum tube engineer for example has contributed much to the flight of man.

Radio communications, instrument landing devices, cross-country beacons and other new and secret electronic equipment are as important to modern air travel as the wings, motor and fuselage. The thing that makes these devices function is the vacuum tube.

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☆ Six ways to Boost Production with no Increase in Manpower

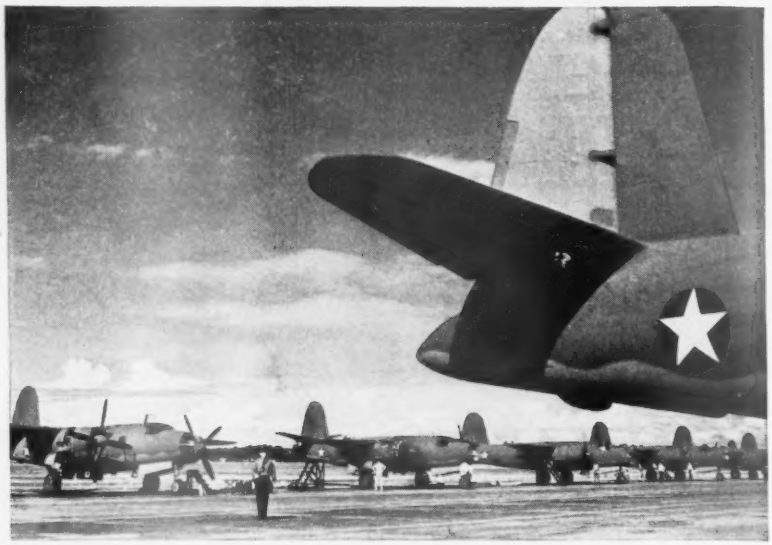
. . . as shown by Glenn L. Martin Records

Encourage Workers' Suggestions: Martin gives cash awards, silver Merit Award pins, membership in the company's Order of the Purple Martin, and a share in proceeds if patentable, for suggestions to speed up production. Many short-cuts, new methods add up to big increases in Martin output. Here Joe Holthaus, Martin worker, studies check received for devising a tool that saves 40% of the time previously devoted to one operation.

Cut Your Accident Rate: Whether minor injuries or serious accidents, they cut manpower, slow production. Martin employs safety engineers, organizes workers' safety committees, supplies movies, lectures, special instructions, and numerous posters. In spite of many new workers, Martin accident rate is well below national figure, steadily decreasing. Here a Martin worker displays a "gas mask," protection against toxic fumes from self-sealing fuel tanks.

☆

Encourage Ride-Sharing: Poor transportation facilities may cause workers to quit or be periodically late. Moreover, there is less chance of absenteeism if other workers call for the potential absentee. Martin set a national record of 4.5 passengers for each car. Martin traffic control and



Go After Subcontractors: Don't wait for subcontractors to come to you. Martin keeps 40 men of its Procurement Dept. on the road, lining up subcontractors, helping them convert. Result: firms that made bottle-caps are turning out wingspars . . . awnings become parachute slings . . . milk cans become exhaust stacks. Today, 30% of all Martin work is subcontracted, more fighting planes like those shown above, are being produced.

parking facilities have ended pedestrian accidents, cut vehicular accidents by 60%.

☆

Watch That Morale: Posters, organized recreation, good lunches, modern working conditions, houseorgan, merit awards, all raise Martin morale. But little things count, too. Experimentally, Martin found that red work benches made workers short-tempered, blue induced sleepiness, green nausea. A neutral tint upped production. Attractive slacks, called Martinalls, aid feminine morale. Special advisors help solve personal problems. Absenteeism has been reduced far below national average by special services and facilities set up to aid employees. Below, Family Day, with Martin families guests of company.

Stay In the Scrap: Organized scrap collection in Martin plants helps prevent work slowdown through lack of raw materials. Enough material is salvaged from building of 2 Martin bombers to build a third. Many imperfect parts, instead of being scrapped and labor wasted, are adapted for other jobs. Martin invented mechanical rivet-sorter to sort thousands of dropped rivets, saves endless man-hours of hand sorting. Above, Martin scrap going back to the mills for re-use.

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Martin findings on any of the above production aids available upon request by plants engaged in war work. Write: THE GLENN L. MARTIN COMPANY, BALTIMORE, MD., U. S. A.

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Womanpower. Sections discuss the potential sources of industrial woman power, types of work in which women prove effective, the relative strength of men and women, testing women for job fitness, factory re-engineering to accommodate women workers, recommendations to employers, and the supervision of women in industry. A survey conducted by United States Employment Service, covering 1,859 occupations in 21 key war industries and 927 occupations in nonwar industries where there is now an active labor demand, is quoted. Aircraft companies surveyed included Consolidated, Boeing, and Vultee.

Report No. 134, titled *Industry Report on Supervisory Training,* contains the results of an analysis of 15,000 replies to a questionnaire. Comments are given on the answers, and the figures are tabulated. *George S. May Business Foundation,* Chicago, Ill.

Labor Recruits from School

Lockheed's Youth Movement, Jack Schmidt. An account of how Pasedena Junior College students are helping to build Lockheed planes. These 16- and 17-year-old boys attend school for a month and work at the Lockheed plant for a month. They are paid standard wages for full eight-hour days and receive school credit for their work. *Lockheed-Vega Aircraftsman,* February

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(*Continued from page 21*)

metal J. The horns were made of cast alloy A9v. The mechanical properties of these extrusions are shown in Table 8.

Sheet and Plate

Only one alloy (AM503, corresponding to Dowmetal M) was used for sheet and plate applications. The chemical composition is shown in Table 5. The manganese content of the sheet is high compared to American practice. Applications of magnesium sheet are shown in Figs. 24–27.

Several fabricated sections are shown in Fig. 24. These were made by forming and welding. A method used to stiffen the edge of the sheet is shown in the cable shield (M52A). This consists of rolling the edge of the sheet and welding as shown in the macrograph. Practically all stiffeners used on these parts were aluminum alloy and were fastened by riveting.

Several fairings are shown in Fig. 25. These were also fabricated by forming and welding. The horizontal fin extension (M50A) had a small magnesium extrusion (M50B) for a stiffener. All rivets used were aluminum alloy of the Duralumin type. A filler block was used in the horizontal fin extension (M50A) where the two sheets come to a point. In the wing fairing (M54A) a filler block can also be seen.

Fig. 26 shows several fabricated assemblies. The pilot seat (M58A) was fabricated of Elektron AM503 sheet by riveting, using aluminum rivets. The edge was stiffened by AM503 extruded tubing welded at the corners. The method used was to bend the sheet over the tube and rivet sheet to sheet. Note the cut out of the sheet at the corners. The rear gunner's seat (M57) was fabricated entirely of magnesium alloy. The pedestal (M57D) was an AZF casting. The seat bottom was also a magnesium casting. The seat was made of AM503 sheet and reinforced with tubing in the same manner as above. The switch box cover (M53A) was made by bending and welding the corners. The insert

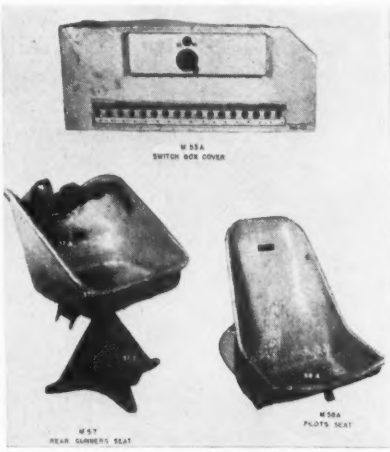

FIG. 26 (*left*).

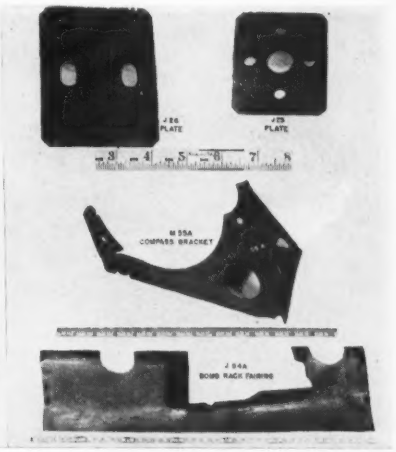

FIG. 27 (*right*).

was made in the same way and attached by means of rivets.

Fig. 27 shows a compass bracket (M55A) and a bomb rack fairing (J94A). The only examples of plate which were found are also shown (J25 and J26). The parts were used on the motor-mount assembly. The mechanical properties of the sheet used are shown in Table 8.

CONCLUSION

(1) Magnesium parts on the airplanes were found as sand castings, die castings, forgings, extrusions, and sheet.

(2) The compositions used were magnesium-aluminum-manganese-zinc and magnesium-manganese types similar to those used in the United States.

(3) Contrary to American practice of using most castings in the heat-treated condition, the Germans used a high percentage of the castings in the as-cast condition.

(4) The more important castings were used in the heat-treated condition.

(5) No serious corrosion was observed in spite of the fact that the basic corrosion resistance of the metal, as well as the protection afforded, was inferior to American practice.

(6) Only a small amount of extrusion and sheet applications were found.

(7) Of especial interest is the rather extensive use of forgings. The more important forgings were the engine mounts, dive brakes, and supercharger impeller.

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[6] Beck, A., *The Technology of Magnesium Alloys:* F. A. Hughes & Co., Ltd., London, 1940.

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DOAK AIRCRAFT COMPANY, LTD.
DOUGLAS AIRCRAFT COMPANY, INC.
- EL SEGUNDO DIVISION
- LONG BEACH DIVISION

DOWTY EQUIPMENT CORPORATION
EASTERN AIR LINES, INC.
EATON MANUFACTURING COMPANY
EDO AIRCRAFT CORPORATION
THE ELECTRIC AUTO-LITE COMPANY
ENGINEERING AND RESEARCH CORPORATION
ETHYL CORPORATION
THE FAFNIR BEARING COMPANY
FAIRCHILD AVIATION CORPORATION
- FAIRCHILD AERIAL CAMERA CORPORATION
- FAIRCHILD AERIAL SURVEYS

FAIRCHILD ENGINE & AIRPLANE CORPORATION
- DURAMOLD DIVISION
- FAIRCHILD AIRCRAFT DIVISION
- RANGER AIRCRAFT ENGINES DIVISION

FEDERAL TELEPHONE & RADIO CORPORATION
FIRESTONE AIRCRAFT COMPANY
FLEETWINGS, INC.
GENERAL AVIATION EQUIPMENT COMPANY, INC.
GENERAL ELECTRIC COMPANY
GENERAL MOTORS CORPORATION
- AC SPARK PLUG DIVISION
- AEROPRODUCTS DIVISION
- ALLISON DIVISION
- BUICK MOTOR DIVISION
- CADILLAC MOTOR CAR DIVISION
- CHEVROLET MOTOR DIVISION
- DELCO PRODUCTS DIVISION
- DELCO-REMY DIVISION
- EASTERN AIRCRAFT DIVISION
- FISHER BODY DIVISION
- FRIGIDAIRE DIVISION
- HARRISON RADIATOR DIVISION
- RESEARCH LABORATORIES DIVISION
- ROCHESTER PRODUCTS DIVISION

GENERAL TIRE & RUBBER COMPANY
THE B. F. GOODRICH COMPANY
GOODYEAR TIRE & RUBBER COMPANY
GRUMMAN AIRCRAFT ENGINEERING CORPORATION
GUIBERSON DIESEL ENGINE COMPANY
W. & L. E. GURLEY
HAMMOND AIRCRAFT COMPANY
HASKELITE MANUFACTURING CORPORATION
HAYES INDUSTRIES, INC.
HIGGINS AIRCRAFT, INC.
INTERCONTINENT AIRCRAFT CORPORATION
THE INTERNATIONAL NICKEL COMPANY
INTERSTATE AIRCRAFT AND ENGINEERING CORPORATION
- WILSHIRE DIVISION
- EL SEGUNDO DIVISION
- DE KALB DIVISION

JACOBS AIRCRAFT ENGINE COMPANY
CASEY JONES SCHOOL OF AERONAUTICS
JORDANOFF AVIATION COMPANY
KELLETT AUTOGIRO CORPORATION
KENYON INSTRUMENT COMPANY, INC.
KOLLSMAN INSTRUMENT DIVISION, SQUARE D COMPANY
LEAR AVIA, INC.
LOCKHEED AIRCRAFT CORPORATION
THE MARQUETTE METAL PRODUCTS COMPANY
THE GLENN L. MARTIN COMPANY
WARREN McARTHUR CORPORATION
McDONNELL AIRCRAFT CORPORATION
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
NASH-KELVINATOR COMPANY
NATIONAL CITY BANK OF NEW YORK
NATIONAL MACHINE PRODUCTS
THE NATIONAL SCREW & MANUFACTURING COMPANY
NORMA-HOFFMANN BEARINGS CORPORATION
NORTH AMERICAN AVIATION, INC.
NORTHROP AIRCRAFT, INC.
NORTHWEST AIRLINES, INC.
PACKARD MOTOR CAR COMPANY
PAN AMERICAN AIRWAYS SYSTEM
THE PARKER APPLIANCE COMPANY
PHILLIPS PETROLEUM COMPANY
PIONEER PARACHUTE COMPANY, INC.
PUMP ENGINEERING SERVICE CORPORATION DIVISION, BORG-WARNER CORPORATION
THE PURE OIL COMPANY
REPUBLIC AVIATION CORPORATION
RIDGEFIELD MANUFACTURING CORPORATION, AIRCRAFT DIVISION
JOHN A. ROEBLING'S SONS COMPANY
ROHR AIRCRAFT CORPORATION
ROOSEVELT FIELD, INC.
SCOTT AVIATION CORPORATION
SHAKESPEARE PRODUCTS COMPANY
SHELL OIL COMPANY, INC.
SOCONY-VACUUM OIL COMPANY
SOLAR AIRCRAFT COMPANY
SPERRY GYROSCOPE COMPANY
STANDARD OIL COMPANY OF CALIFORNIA
STANDARD OIL COMPANY (INDIANA)
STANDARD OIL COMPANY OF NEW JERSEY
STEWART-WARNER CORPORATION
SUMMERILL TUBING COMPANY
SWITLIK PARACHUTE COMPANY
TELEFLEX LIMITED
THE TEXAS COMPANY
THOMPSON PRODUCTS, INC.
TRANSCONTINENTAL & WESTERN AIR, INC
UNITED AIRCRAFT CORPORATION
- CHANCE VOUGHT AIRCRAFT DIVISION
- HAMILTON STANDARD PROPELLERS DIVISION
- PRATT & WHITNEY AIRCRAFT DIVISION
- SIKORSKY AIRCRAFT DIVISION

UNITED AIR LINES TRANSPORT CORPORATION
UNITED CARR FASTENER CORPORATION
UNITED STATES AVIATION UNDERWRITERS, INC.
UNITED STATES RUBBER COMPANY
- DOMINION RUBBER COMPANY, LTD.

UNIVERSAL MOULDED PRODUCTS CORPORATION
VEGA AIRCRAFT CORPORATION
WARNER AIRCRAFT CORPORATION
THE WEATHERHEAD COMPANY
WESTERN AIRLINES, INC.
WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
WESTON ELECTRICAL INSTRUMENT CORPORATION
WHITING CORPORATION, AVIATION DIVISION
WYMAN-GORDON COMPANY

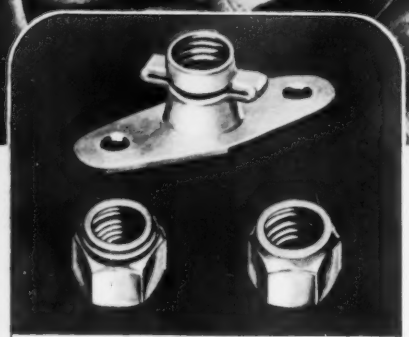
WRIGHT POWERS THE TONNAGE OF THE AIR

WATCHWORD from Tulagi to Tunis

DEEP in a concrete vault, the Naval Observatory's time machine ticks out a signal broadcast around the world. Our national coordination is keyed to this watchword of accuracy. For the physical coordination we depend on another precision time machine — the aircraft engine — which makes the most of time available. Wright engines, in larger, swifter carriers, are the watchword of progress in time-saving, tonnage air transport.

LIGHT
COMPACT
POWERFUL

Wright ENGINES



200 Rounds May Spell the Difference

Boots all-metal, self-locking nuts are lighter than ordinary nuts. Their use on heavy bombers saves more than sixty pounds of precious weight—a saving which can be turned into sixty pounds of fire-power, or about 200 rounds of .50 calibre machine gun ammunition. And those 200 rounds may easily mean the difference between "all our aircraft returned safely" and "one of our aircraft is missing."

All types of U. S. planes are protected with Boots Nuts. Not only are these nuts lighter, but they literally "outlast the plane." Furthermore Boots Nuts cut repair and maintenance time and have great reusability. They meet the exacting requirements of all government agencies.

"They Fly With Their Boots On—*Lighter!*"

When the War is Over . . .

Boots Self-Locking Nuts will have even more widespread usefulness. Today, they are used in a variety of applications, including all types of AIRCRAFT, AUTO HEADLIGHTS, RADIO CONDENSERS, etc. Tomorrow, they will lengthen the life of your AUTOMOBILE, BICYCLE, WASHING MACHINE, VACUUM CLEANER, ELECTRIC REFRIGERATOR, and many other household appliances, as well as industrial, farm, and office machinery. Boots Nuts provide positive protection of *permanent* fastening wherever vibration, corrosion, or temperature are factors.

BOOTS

Self-Locking Nuts For Application In All Industries

BOOTS AIRCRAFT NUT CORPORATION ★ GENERAL OFFICES, NEW CANAAN, CONNECTICUT

From the Industry

Hose Clamps

Aero-Seal hose clamps are made in 14 sizes from $^3/_4$- to 4-in. inside hose diameter. They have been designed with a number of improved features based on the requirements set forth in Army Air Forces Specification No. 25529.

The clamp consists of a $^9/_{16}$-in. tempered steel band punched with holes corresponding to the teeth of a worm gear. These holes mesh with a worm in the housing welded to the fixed end of the band. The worm is turned by a screw driver, and the screw head on the worm is fitted with a safety cup to prevent the screw driver from slipping and puncturing the hose or damaging other equipment. Rapid action is obtained by a ten-pitch thread so that full take-up is obtained with only a few turns of the screw driver. The belt-like tightening action is intended to produce a uniform tangential pull which does not distort the pipe and results in a leakless clamping action. By backing up the screw, the free end of the band comes out of the housing, and the clamp may then be sprung open and slipped over the hose in place on the pipe. A clamp can be removed in a similar manner. Aircraft Standard Parts Company, Rockford, Ill.

Dies and Fixtures

Algoma Products has been formed in Detroit for the large-scale manufacture of template dies and fixtures for the aircraft industry and others. The company has taken over the plant of the former fixture division of the Weltronic Corporation and is also operating a second plant in the Detroit area. It will continue to produce such fixtures, but its most important product is a line of blanking and piercing dies to be produced from templates of parts on a quantity-production basis.

The new dies are claimed to eliminate the necessity for separate die design and do not require highly specialized production equipment. The process has been laid out in such a manner that a large number of die makers are not required. Much of the production can be handled by mechanics with only normal skill in the operation of specific types of conventional machine tools. Algoma Products, Detroit, Mich.

Sealed Switches

Allied Control Company's type A3 and A5 switches for control of aircraft and ground equipment are sealed in Bakelite cases to protect their contacts against effects of dirt, dust, sand, and oils. Operating characteristics of Allied A3 and A5 sealed switches are as follows: contact arrangement—single-pole single-throw (A3—normally closed, double break; A5—normally open, double break); contact ratings—non-inductive, 50-amp. at 12 and 24 volts d.c. and 110 volts a.c.; operating pressure—$1^1/_2$ to $3^1/_2$ lbs.; plunger travel—travel differential 0.006 to 0.012 in.; overtravel—0.050 to 0.070 in. at maximum pressure; weight—5 oz.; dimensions—$1^{15}/_{16}$ by $1^{15}/_{16}$ by $1^{19}/_{32}$ in. The Allied Control Company, New York, N.Y.

Humidity Test Chamber

A low- and high-temperature test chamber is now being produced with automatic humidity control. The standard humidity range is ambient to 140°F.—ambient to 90 per cent relative. Special adaptation can be made for humidities below ambient if requirements are known.

The unit, known as model RTC-1H, embodies, as an integral part, equipment for mechanical refrigeration and electric heating which affords fast rates of temperature and humidity change. Its temperature range is −55° to +70° C. (−67° to +160°F.). Other features include the use of a two-stage Freon condensing unit and special refrigeration accessory developments that make possible extremely flexible operation at various loads and temperatures.

Observation of products under test is provided by a door having five sealed and dehydrated panels of glass. The steel frame door has a clear opening $51^1/_2$ in. wide by $26^1/_2$ in. high. Access electrically or mechanically to the test space for equipment is provided. The exterior overall measurements are: 95 by 91 by 42 in.; interior 52 by $27^1/_2$ by 30 in. The interior content is 25.9 cu.ft. American Coils Company, Newark, N.J.

The Auburn ceramic spark-plug connector.

Interchangeable Check Valves

The ASP universal check valve for aircraft hydraulics employs the principle of interchangeability in such a way that, by the use of a standard body made of heat-treated aluminum alloy and two of any of three types of adapters, six basic combinations of connections are possible with flared tubing or internal or external pipe threads.

Each adapter is provided with a seat for a phenolic poppet. By reversing the position of the poppet or the entire valve assembly, the direction of fluid flow can be changed, making a total of twelve possible combinations. American Screw Products, Los Angeles, Calif.

Aircraft Spark-Plug Connector

The Auburn ceramic spark-plug connector is designed to assure constant contact for ignition wire and spark plug on all types of shielded aircraft harness. The terminal is made with a sleeve of vitreous, porcelain ceramic, combining high dielectric and high heat-resistant properties. It is claimed that it will not carbonize, carbon-track, or absorb moisture.

The connector is made in two sizes—$^9/_{16}$- and 1-in. lengths—to serve all applications. Each connector is completely assembled with riveted metal eyelet and stainless-steel contact spring. Auburn Spark Plug Company, Inc., Aircraft Division, Newark, N.J.

Automatic Electric Class "S" Relays

The makers state that tests of the new Class "S" relays with a cathode-ray oscilloscope—sensitive to $^1/_{1000}$ sec.—show that contacts do not open at 10.5 G's, and examination under stroboscopic light proves that there is no perceptible movement of the armature in this test. The relays are resistant to humidity and meet operating tests under temperatures from −40 to +130°

SAVE PRICELESS MAN-HOURS

by having us assemble conduit and fittings

We have a large assembling department, staffed by experts, who will assemble fittings and flexible shielded conduit to your own specifications. Every hour of assembling time saved is an hour gained on your production line.

Send us the complete specifications and we'll tell you by return mail how we can handle your assembly to *your* best advantage.

American Metal Hose makes a complete line of fittings and accessories for American Flexible Low-Tension Shielded Conduit (some examples are illustrated above). Both fittings and conduit conform to A-N, A-C and NAF specifications.

43189

ANACONDA

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn. *Subsidiary of Anaconda Copper Mining Co.*
In Canada: Anaconda American Brass Ltd., New Toronto, Ontario

American Metal Hose

F. and insulation tests on a.c. voltages up to 500.

Twin contacts are supplied, designed to assure one contact "making" even if the other contact is held open by dust or grit. Contacts will make or break 1 amp. noninductive or 1/2 amp. inductive load and will carry 2 amp. Coils are available with 150 to 3,500 ohms resistance.

The small size and light weight of Class "S" relays are intended to meet aircraft requirements. The double-arm relay has two spring pile-ups of up to six springs each, is 1 by 1 1/2 by 1 3/8 in. in size, and weighs 2 oz. The single-arm relay has one pile-up (maximum, six springs), is 3/4 by 1 1/2 by 1 3/8 in. in size, and weighs 1 2/3 oz. Springs may be in any arrangement of "make," "break," and "break-make" combinations. Automatic Electric Company, Chicago, Ill.

Remote Control Device

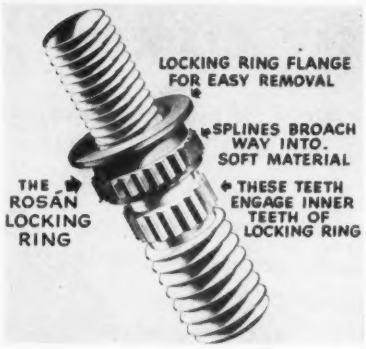
The Barber-Colman Micropositioner has been designed primarily for aircraft service. It is a polarized direct current voltage sensitive relay used for remote positioning of control motors and the control of air valves, engine cowling flaps, trim tabs, and similar aircraft installations.

The contact tongue is positioned by means of a balanced armature. The construction is claimed to be so designed that the effect of vibration is reduced to a minimum. The entire operating mechanism is mounted on a Bakelite base and enclosed in a transparent Lucite case to afford convenient contact inspection without the removal of the cover. Specifications are as follows: sensitivity—0.10 volts, 0.002 amp.; weight—6 oz.; contact rating—0.5 amp. at 28 volts (non-inductive load). Barber-Colman Company, Rockford, Ill.

Removable Terminal Stud

The Rosán removable terminal stud, which is inserted from the front and is intended to eliminate shielding, is a new application of the Rosán locking system for threaded inserts and studs.

To install this stud, the soft material is bored and threaded from the front to a depth sufficient for the stud to be screwed in and locked in the material with the Rosán locking ring. As in all applications of this system, the steel stud is locked in the softer material by means of a steel locking ring, serrated inside and out. When the ring is driven into place, its inner teeth engage the teeth of a serrated collar on the stud. The outer teeth broach their way into the material. Pressure of surrounding material causes the ring to close in on the serrated collar, making a solid unit of the whole.


LOCKING RING FLANGE FOR EASY REMOVAL
SPLINES BROACH WAY INTO SOFT MATERIAL
THESE TEETH ENGAGE INNER TEETH OF LOCKING RING
THE ROSÁN LOCKING RING

A removable terminal stud, a new application of the Rosán locking system for threaded inserts and studs.

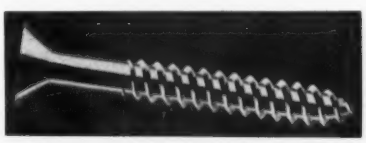
On the terminal stud, a special locking ring with a flange is used. By means of this flange, the ring may be pried out and the stud unscrewed and removed without injury to the material. The panel does not have to be taken off in order to replace an individual stud. Bardwell & McAlister, Inc., Hollywood, Calif.

Twin Thread Screw

A new screw for wood, plastic, and combination assemblies has been registered as the Twin-Fast screw and has patented features in shank, thread, and point. These features are designed to effect faster, tighter, and neater fastenings.

The Twin-Fast screw has two parallel threads that start at opposite sides of the shank and terminate in a single, centered point. The twin-thread construction is reported to afford a greater thread pitch than does the conventional screw, so that the driving speed is doubled. The driving torque is only nominal, since the twin-thread construction provides the standard number of threads per inch.

Another claimed advantage for use with plastic assemblies is that Twin-Fast screws are self-tapping. They are cylindric in contour (not tapered). The thread area is increased to provide more extensive contact, tighter seating, and greater holding power than with tapered screws. The manufacturer states that because of this factor shorter screws and even fewer screws often can be used.



The Twin-Fast screw for wood, plastic, and combination assemblies has two parallel threads that start at opposite sides of the shank and terminate in a single, centered point.

The relieved shank diameter is designed to avoid stresses that may be set up by the shank which cause fractures or ruptures, a feature planned for assemblies subjected to more than ordinary changes in temperature and humidity. Twin-Fast screws are available in all standard sizes, in steel and brass, with round, flat, and oval heads. The Blake and Johnson Company, Waterville, Conn.

New Navy Fighter

The United States Navy's Brewster F3A fighter is a counterpart of the F4U Corsair and is designed for carrier operations with the Fleet. This gull-winged, single-seater monoplane is powered by a 2,000-hp. Pratt & Whitney air-cooled engine.

The Brewster F3A was recently test-flown at the Brewster plant. All divisions of Brewster Aeronautical Corporation are at work manufacturing parts or assembling the new fighter for the Navy. Other manufacturers turning out the Corsair fighters for the Navy are the Chance Vought Division of United Aircraft Corporation and Goodyear Aircraft. Brewster Aeronautical Corporation.

Plastic Case for Vibro Tool

A 1-lb. Burgess vibro tool has a molded Lumarith plastic case with ball grip. Features claimed for the plastic include the saving of metal, its light weight, satisfactory impact strength, and insulation against electric shock.

The vibro tool is used to place identification marks on tools, materials, and parts. Special attachments are available at nominal cost for filing, cutting, hammering, and chiseling. The makers state that the tool will run all day without overheating and uses only about 15 watts. It is furnished with a supply of cutting needles for engraving metals, plastics, and glass. Celanese Celluloid Corporation, division of the Celanese Corporation of America.

Cessna Loadmaster

Preliminary factory tests have been completed on the new Cessna Loadmaster cargo plane and it is expected to undergo flight tests by the Army Air Forces soon.

The Loadmaster is designed as a "front-line dispatcher" to carry men and supplies from main airfields and supply bases to actual battle areas, landing and taking off on small fields that larger planes cannot use.

The new plane was designed expressly as a cargo carrier and does not represent the conversion of an existing military or commercial type to transport use. Its construction is arranged to achieve high pay load per pound of air frame with speed, safety, and flexibility of use.

MASTER OF MANY CLIMES

You will find the Allison engine busy today in the tropic heat of equatorial regions, and the numbing cold of near-polar areas. ★ You will find it strafing the enemy from the palm tops of jungle country and through the ground haze of the desert—you will meet it, too, in the sub-arctic temperatures of the upper air. ★ But wherever you find it, you find sturdy dependability doing a masterful job, carrying the fighting pilots of the United Nations successfully on their missions—then winging them safely home again. ★ The Allison is manufactured under General Motors standards of engineering, metallurgy and fabrication. ★ Planned from the outset to be one of the world's finest aircraft engines, the Allison is living up to General Motors' purpose in creating it—and in the process proving itself master of every climatic condition under which men fight.

POWERED BY ALLISON

P-38—Lightning
P-39—Airacobra
P-40—Kittyhawk
P-51—Mustang

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF GM GENERAL MOTORS

The fuselage is of welded steel tubing, the wings of plastic plywood, and the entire structure is fabric-covered. Composite steel tubing and plywood construction is claimed to have demonstrated its value in combat flying. It is stated that shells pass through wooden construction with no more disastrous results than in metal-formed aircraft and the damage is usually quickly and inexpensively repaired. The plane is powered by two 600-hp. Pratt & Whitney engines. Cessna Aircraft Company.

Corrosion Protection

A coating for metal products, claimed to be new and virtually priority-free, has recently been developed. The new finish or coating, called "Armor-Vit," is at once a material and a process. While the trade name suggests a material ceramic in nature, there is no relationship between this new development and porcelain enamel, and, being inorganic, it does not compare with paint, lacquer, or the synthetic finishes. Armor-Vit is essentially an alkali alumina silicate, one source of which is a new ingredient, an oil-bearing halloysite.

The coating is applied in either one or two coats at 0.0005 to 0.0010 in. in thickness. For its application the metal is cleaned by ordinary cleaning methods —alkali cleaner, acid pickling, and neutralizing. Sand-blasting is usually recommended for cast iron. After the application of Armor-Vit by ordinary spraying equipment or dipping method, the curing treatment (best accomplished in an indirect-fired, air-circulating oven with proper temperature control and capable of heating to 750° to 800°F.) combines the ingredients of the coating into a hard, heat-resisting finish, insoluble in boiling water and highly resistant to most acids and alkalies.

The new finish is intended to withstand such acids as acetic, sulfuric, nitric, and hydrochloric and to resist such chemicals as cold concentrated caustic soda, ethyl alcohol, toluene, ether, sodium chloride solution, calcium chloride solution, ammonium hydroxide, and trisodium phosphate. Chicago Vitreous Enamel Product Company, Cicero, Ill.

Adjustable Surface Facer

The Clark surface facer is an adjustable tool for surface facing in horizontal or vertical milling machines, lathes, and other spindle machines. It consists of a tapered (or straight) shank and body with three adjustable high-speed bits that may be set for any diameter within the range of the tool. With four tools, any diameter from 1 to 5 in., inclusive, may be obtained without being limited to standard fractional dimensions. A measuring gauge is provided with each tool for quick and accurate size adjustments. The bits can be reground or can be replaced with new bits at comparatively small cost.

The tool is designed for dressing castings of any metal, dovetailing, spot facing; as an emergency repair tool; and many other end mill, facing mill, or slab mill operations. Robert H. Clark Company, Los Angeles, Calif.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Rivet Injector

The Cleco Riv-N-Jector is intended to facilitate the work of the riveter and to remove the cause of dropped rivets. It provides an ample supply of rivets and avoids repeated trips to the rivet center.

The tool has a magazine holding up to 50 rivets. A special nose jaw holds a single rivet ready at all times for inserting into the hole in the metal. The operator is relieved of the handling of loose rivets and can keep his or her attention on the riveting operation.

In connection with the use of the tool, the maker has devised suggested plans for laying out a complete riveting department. These plans comprise arrangement of hoppers for the rivets and storage boxes for both hot and cold operations. The layout, with its rivet stations and rivet centers, is based on actual recommended practice as installed in several large airplane fabricating plants. Complete information is available in the company's Bulletin 89. Cleveland Pneumatic Tool Company, Cleveland, O.

Feed-Thru Terminal Block

The Curtis Feed-Thru multiple terminal block for subpanel and chassis construction is designed to meet present-day demands of electronic and electrical design which require external terminals because of the wiring simplicity and other advantages of that type of terminal.

The terminal block consists of individual feed-through terminals, mounted in Bakelite, which are permanently held in a metal strip in any combination desired. Factory production now includes blocks having any number of units between one and ten, but, because of their sectional design, blocks can be supplied with any number of terminals needed.

Terminals have ample clearances and leakage distances for circuits carrying up to 300 volts, 20 amp. Center-to-center distance between terminal units is $^5/_8$ in. No. 8 screws are used on each side of terminal units for securing connection. The two mounting holes at each end of the terminal base take No. 8 machine screws. Curtis Development and Manufacturing Company, Chicago, Ill.

Consolidated Vultee to Build Douglas Havoc

It has been announced that the Douglas A-20 Havoc shortly will be put into production at the Tennessee plant of Consolidated Vultee under Douglas license.

The Havoc is reported as being used extensively by the British, who have adapted it to 27 combat purposes, including low-altitude bombing, troop strafing, fighting, intercepting, intruding, and smoke-screen laying. Douglas Aircraft Company, Inc.

Lightweight Limit Switch for Aircraft

A lightweight, dust-tight limit switch, specially designed for aircraft applications where space is limited, has a contact mechanism of the snap-action, double-break type which gives it a high current rating and makes it suitable for applications where severe vibration conditions are encountered.

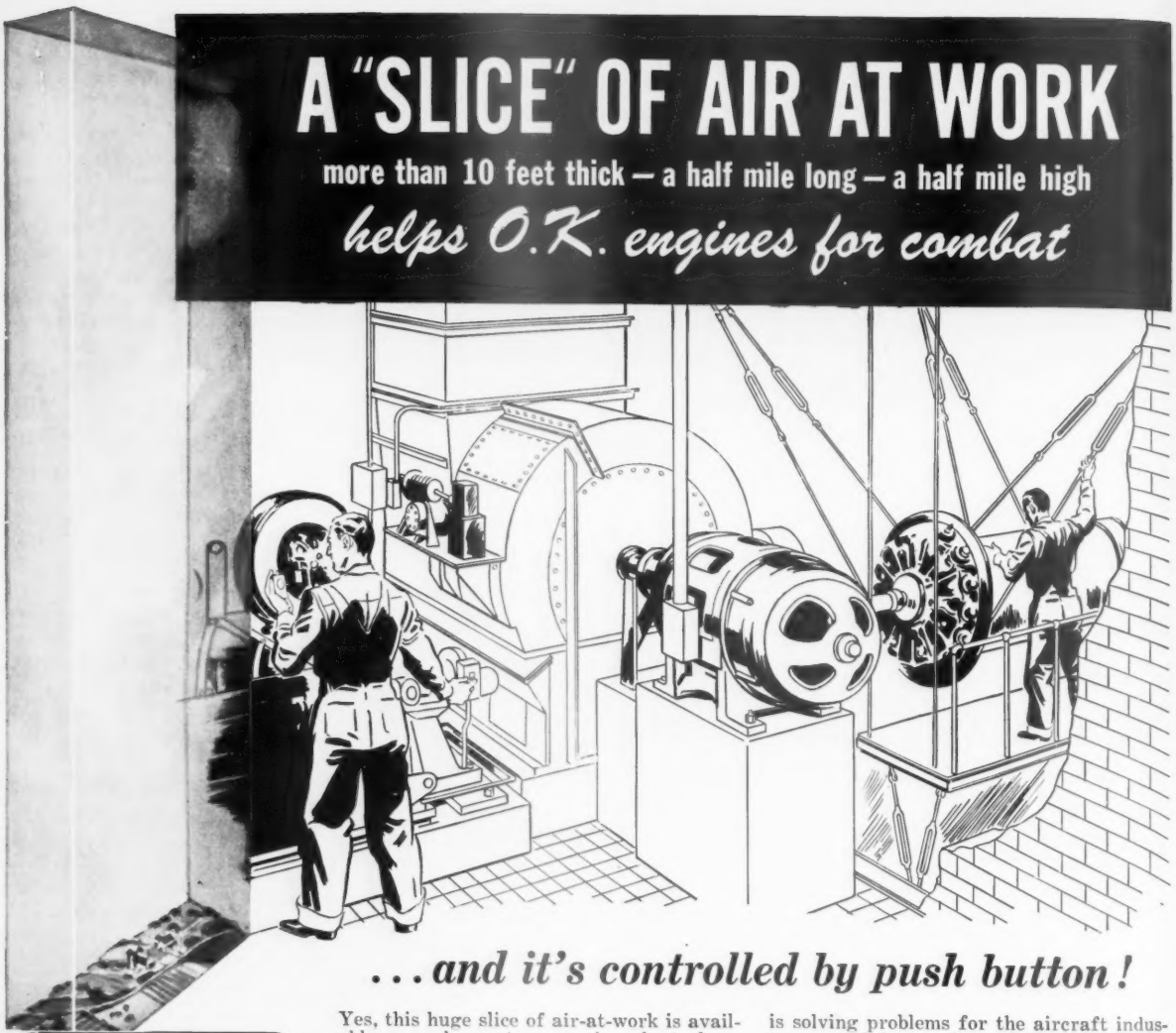
The switch is designed for use in a wide range of ambient temperature from +95° to −40°C. It is claimed to be corrosion-proof, meeting 200-hour salt water tests as stipulated by various government agencies, and is suitable for use at altitudes from sea level to 40,000 ft.

The new switch is a spring-return, plunger-operated type with a $^7/_{32}$-in. overtravel. It can be mounted either on the cover side or on the opposite side, thus facilitating the operation of the plunger from either the right or the left. It is available in three different contact arrangements—single-circuit, normally open; single-circuit, normally closed; and two-circuit, normally open and normally closed. It is also furnished with either die-cast zinc or die-cast aluminum housings and with either solder lug connections or, in the single-circuit forms, with an AN connector insert built in the AN threaded nipple of the housings. In addition, the switch is available with a rubber boot mounted over the plunger-operating mechanism for use in locations where mud and sand are encountered. General Electric Company.

A "SLICE" OF AIR AT WORK

more than 10 feet thick — a half mile long — a half mile high

helps O.K. engines for combat



. . . and it's controlled by push button!

Yes, this huge slice of air-at-work is available every hour at one engine plant alone, where dynamometer tests of motors, under load on test blocks, demand a hurricane of cooling to keep oil temperature down to regular operating levels . . . simulate actual flight conditions.

To provide a chunk of air this size every hour called for *air engineering*—and close control. In this plant, 29 giant Sturtevant Fans like the one shown above are on duty. Many are capable of delivering 55,000 c.f.m., at the hurricane speeds that correspond to that of the airstream on fast aircraft. A total of 78,420,000 cubic feet of air per hour, Sturtevant-engineered to meet varying requirements, to speed testing, to save operating costs.

All control of this tornado is centered in push buttons, which open or close the patented Sturtevant Inlet Vanes, varying the output of the fan instantly. Thus, while the fan runs at constant speed, power input to the motor is varied by this control of air delivery, saving power at reduced loads.

This is just one of the ways that Sturtevant is solving problems for the aircraft industry—supplying *engineered air* that controls hazardous dust and fumes, heats, ventilates and air conditions plant areas, humidifies and dries plywood, conveys shavings and other light materials—in short, steps up production wherever aircraft and their components are made.

Have you a problem that "air at work" can help solve? With 83 years of air handling experience, Sturtevant is in a position to work closely with aviation engineers who are producing equipment for today or designing it for tomorrow.

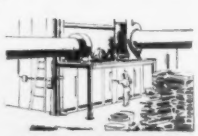
B. F. STURTEVANT COMPANY
Hyde Park Boston, Mass.

STURTEVANT EQUIPMENT FURNISHED FOR THE FOLLOWING PLANTS
in the Aviation Industry

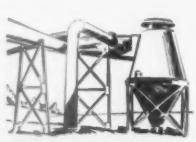
- Bendix Aviation Corp.
- Boeing Aircraft Co.
- Brewster Aeronautical Corp.
- Curtiss-Wright Corp. (3 plants)
- Curtiss-Wright Propeller Div.
- Fairchild Engine & Airplane Corp.
- Firestone Rubber & Latex Prod. Co.
- Ford Bomber Plant
- Ford Engine Plant
- Goodyear Aircraft Corp.
- Marietta Bomber Plant
- Glenn L. Martin Co. (3 plants)
- Studebaker Aircraft Engine Co. (2 plants)
- Wright Aeronautical Corp. (2 plants)
- United Aircraft Corp.
- Pratt & Whitney Div.
- Hamilton Standard Propeller Div.
- Numerous Naval Air Stations and Lighter-Than-Air Bases

Sturtevant
REG. U.S. PAT. OFF.
Puts Air to Work

Units or systems for Heating and Ventilating

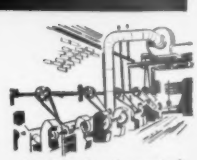


Dryers for plywood and other materials



Pneumatic conveyors for sawdust, metal shavings, etc.

Air conditioning for manufacturing areas



Systems for the control of Dust and Fumes

Improved Precision Coil-Turn Counter

An improved coil-turn counter for laboratory or factory use in determining with precision the number of turns in wound electric coils has been announced. Employing the same circuit as its predecessor, the new counter is more compact in design and incorporates a magnetizing current control box that simplifies the installation. The counter is capable of checking or determining the effective turns of coils ranging from one to 11,110 turns, at a rate of from 80 to 100 coils of like specifications per hour.

In addition to the magnetizing current control box, the new coil-turn counter comprises a portable light-beam galvanometer, two yoked test rods, a galvanometer control panel, and a foot-operated switch—all assembled for operation on a table or bench.

Instead of being mounted separately as with the previous counter, the reference coils of the new counter are enclosed in the galvanometer control case while the test rods are mounted on the case. This arrangement allows the coil to rest close to the reference coil with which it is compared.

The accuracy of the counter is one turn in a thousand for coils having air cores at least $^5/_8$ in. in diameter, an outside diameter of 8 in. and less, a coil build-up to $2^5/_8$ in., and up to 6 in. in height. Accuracy is not so high for coils outside these limits. General Electric Company.

New Time-Delay Relay for Aircraft Applications

A time-delay relay, specifically designed for aircraft applications where time-delay drop-out is required, is available in two sizes, one providing up to 0.4-sec. time delay, and the other up to 0.3-sec. time delay. On many applications this relay can be used directly to control the desired device, while on others it may be desirable to have the relay actuate a contactor.

The new relay employs a principle that consists of delaying the decay of use of a single-turn, low-resistance copper jacket around a section of the magnetic structure. It is designed for use in a wide range of ambient temperature—from +95° to −40°C. It is suitable for mounting in any position and is corrosion-proof, withstanding 95 per cent humidity at 75°C. on 48-hour tests and operating successfully thereafter.

The normally closed, double-break, silver contacts of the relays are planned to carry 20 amp. continuously at altitudes up to 40,000 ft. above sea level. The operating coils can be furnished for operation on either a 12- or a 24-volt circuit.

The makers claim that whether the relay is energized or de-energized, its contacts will remain in the correct position without chattering, even when subjected to mechanical frequencies of from 5 to 55 cycles per sec. at $^1/_{32}$-in. amplitude ($^1/_{16}$-in. total travel), applied in any direction, or when subjected to linear acceleration of ten times gravity in any direction. General Electric Company.

Lightweight Contactor for Aircraft

A contactor specifically designed for aircraft applications where small size and light weight are desirable and where reliable performance under the most adverse conditions is imperative is offered by the maker as especially effective for controlling solenoids and small motors in aircraft.

As designed to conform with the specifications of the U.S. Army Air Forces, the contactor is furnished in two sizes—50 and 100 amp. The 50-amp. type is $2^5/_{16}$ by 2 in. in size and weighs $4^3/_4$ oz., and the 100-amp. type is $2^3/_4$ by $2^5/_8$ in. and weighs 11 oz. The light weight of this contactor is credited largely to its balanced-armature construction.

The new contactor is reported to conform fully to the stipulations of various government agencies with respect to ambient temperature range and corrosion-proof qualities and is suitable for use at altitudes from sea level to 40,000 ft. In addition, it can be mounted in any position on either a metal or nonmetallic base.

The contactor is also available in both these sizes in a form that, while utilizing the same parts, is equipped with a simplified mounting bracket and terminal assembly. This form represents a slight saving in size and weight. General Electric Company.

Tank Linings

A method of bonding solid sheets of Koroseal directly to the welded steel, wood, or concrete from which tanks are made, and thus extending the application of tank linings into fields for which rubber cannot be used because of physical limitations, has been announced. It is stated that the principal advantage of Koroseal in tank lining is its property of corrosion resistance because of the inertness of its compounds to strong corrosives, such as chromic and nitric acids, which have a deteriorating effect on rubber. In announcing the Koroseal linings the maker emphasizes that the material has certain limitations both in temperature ranges and effects of various chemicals on it and that it is essential that complete service details be furnished before the material can be recommended.

The new linings, made in sheets, are three times thicker than an earlier type that employed fabric backing. Among the advantages claimed for the lining are the following: (1) It can be applied in thicknesses up to and including $^3/_{32}$ in.; (2) It is not subject to physical damage and pin hole leaks, but it will not withstand physical abuse and metallic gouging; (3) it is readily repaired if damaged; (4) it has high electrical resistivity and prevents current losses in electrolytic action; (5) it can be easily tested for leaks with an electric tester; (6) it is highly resistant to oxidation, water, sunlight, and gas diffusion. The B. F. Goodrich Company.

Extruded Synthetic Rubber

Extruded parts have been made from Ameripol synthetic rubber, having a durometer reading of only 35—five points less hardness than any natural rubber compound the maker has ever been able successfully to put through extruding machines.

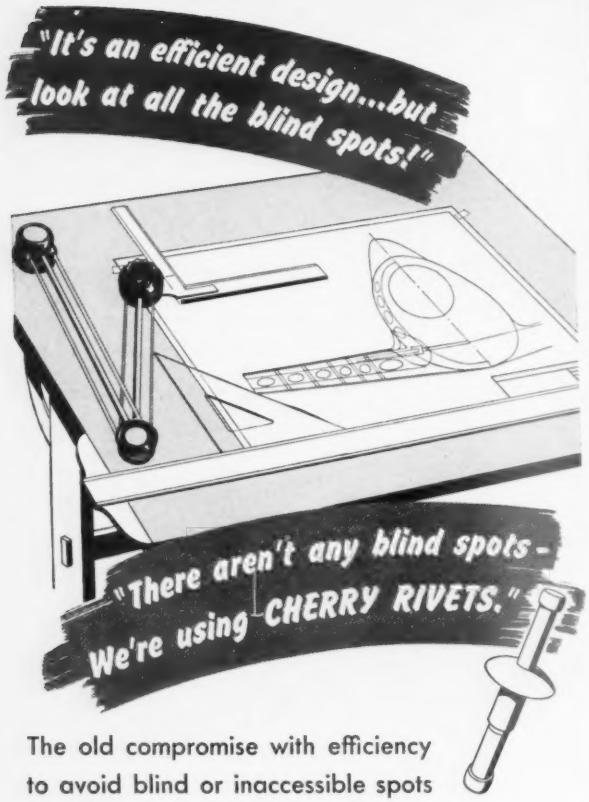
The product was developed to meet the specifications of an aircraft manufacturer who is using it as a compressible sealing device between metal panels where there must not be the slightest air seepage. It has a tensile strength of 700 lbs., elongation of 700 lbs., and can withstand temperatures as low as −40°F. without cracking. Even after 48 hours of immersion at room temperature in a solution of 85 per cent kerosene and 15 per cent benzene, the rubber shows only a $22^1/_2$ per cent decrease in tensile strength and only 15 per cent decrease in elongation.

Besides its application to aircraft, the new compound is expected to find many industrial uses where compounds having higher durometer readings do not compress readily enough to give a desired airtight or liquid-tight seal. The B. F. Goodrich Company.

Channel-Tread Tires

Channel-tread tires have been designed to insure greater safety and permit heavier loads for warplanes, es-

The Goodyear channel tread tire.



The old compromise with efficiency to avoid blind or inaccessible spots in airframe structures has been eliminated by the Cherry Blind Rivet.

This mechanical blind rivet has proved itself in thousands of aircraft and due to its high shear and fatigue values is opening new doors for the engineer. He can now design *up to* efficiency rather than *down to* a manufacturing limitation.

The complete story on Cherry Rivets is available. Request your copy of the new Handbook A-43 from Department 3, Cherry Rivet Company, Los Angeles, California.

CHERRY RIVETS, THEIR MANUFACTURE AND APPLICATION ARE COVERED BY U. S. PATENTS ISSUED AND PENDING.

Cherry Rivet
Company
LOS ANGELES, CALIFORNIA

For Distinguished Service

HELPING TO SPEED THE WINGS OF VICTORY

WE have been honored by the Army-Navy "E" award for high achievement in the production of war materiel.

In every phase of precision production work we do, and trifling compared to what our fighting men are doing, we take special pride in turning out quality equipment, in quantity and on time. Victory is our one objective.

Ours is the task of helping to equip the men on the field and in the air. To them belongs the glory . . . to them belongs the headlines . . . to them belongs the fruits of victory. Let us all remember this when our fighting men return victoriously home.

AND WHEN PEACE COMES

. . . we know that all of us will share in a new America. We, of Lawson, are very proud that we are able to build products to meet the exacting standards of our Navy and Army.

It means that, for the duration, we cannot make our facilities available for civilian-industrial use, but thanks to the experience we are gaining now, we will be better able and more completely equipped to serve you when peace comes.

CELEBRATING OUR 10th ANNIVERSARY

LAWSON
Machine and Tool Company
Malden, Massachusetts

pecially for overcoming conditions encountered in sandy, muddy, or other kinds of soft landing surfaces. They were originally devised for use on Airacobra fighters but are finding applications in warplanes of all types.

Goodyear channel-tread tires have higher and stiffer sidewalls, which provide greater area of contact with the ground or more "flotation" surface. Additional advantages were discovered after the tires were put into service. One was that the higher sidewalls compressed the landing surface, such as sand or earth, between them and against the tread, giving "purchase" for the tread when a plane was landing or taking off.

Another advantage was the increased resistance of the higher sidewalls to landing shocks, guarding against the tire being twisted or jammed against the rim by sudden impacts. It was found that lower air pressures were possible within the tires, which also meant still greater areas in actual contact with the landing surfaces. For example, the Airacobra's tire pressure was reduced from 90 to 67 lbs. with channel-tread tires. The same low-pressure principle prompted adaptation of the channel-tread tires to tail wheels. The Goodyear Tire & Rubber Company.

Bench Bins

Standard bench bins are designed for use directly on the bench in connection with assembly operations, no racks being needed. The bins are raised at the back to provide the proper forward tilt for gravity feed of parts toward the front and rest firmly on the bench.

These bins are made in widths ranging from 2 to 8 in. and capacities from $^1/_2$ to 6 pints. All bins are $7^1/_4$ in. long. The Gordon L. Hall Co., Old Lyme, Conn.

Infra-Red Insulated-Reflective Oven

The Miskella infra red oven was designed to combine the features of heavily insulated convection baking ovens with those of the new infra red method that delivers the heat rays directly to the product in process without intermediate transfer of heat. All panels are in standardized sections, are insulated-reflective, and are filled with Fiberglas. Sections are completely wired ready to connect to the power service. Use is made of blank insulated-reflective panels which "billiard" heat rays about within the oven without additional electric power. Loose insulated blank panels may be laid on the floor to aid in processing extremely long parts. Remote control switches, automatic starting and stopping, and automatic draft adjustments are included when needed.

In addition to the primary air circulation upward within the oven proper, there is the secondary air circulation that meets the primary air in the fume duct above and where both join and go out the chimney together. The secondary airflow continues to function even with the primary flow cut off. Secondary air passes between the back of the insulated-reflective panels and the exterior covering of the oven. Fume ducts are sectional and easily removable. Infra-Red Engineers & Designers, Cleveland, O.

Kenyon "Piccolo" Valve

A single housing of a group of valve units that discharge into a common return line has been developed for use in high pressure hydraulic systems of military and commercial aircraft. The new Kenyon combination multiple check-relief valve assembly, known as the "Piccolo" valve because of its shape, is designed to centralize the thermal expansion relief valves of several closed hydraulic systems and to simplify service maintenance through the location of this assembly in an accessible place on the aircraft.

While each unit valve in the assembly normally contains a check valve and a relief valve mechanism, the valve is generally furnished with certain units containing only relief valves or check valves—one or the other of the two valves in each unit being eliminated. Different size pipe fittings are available on a single-valve for connection to hydraulic tube fittings of other than all the same sizes.

Each relief valve is individually adjustable and may be set for any desired opening pressure from 100 to 2,000 lbs. per sq.in. All of the relief valves are provided with locking means on the adjusting screw, and safety wired caps cover the entire adjustment.

The body of the valve is formed from a solid aluminum-alloy extrusion. A plastic poppet type of check valve is used and the relief valve employs a hardened steel ball coacting with a hardened steel seat. Synthetic rubber gaskets are employed where necessary to provide a mechanism that is sealed against internal and external leakages at all pressures up to and including 2,000 lbs. per sq.in. All aluminum parts of the assembly are anodically treated. The valve is assembled in any size containing from one to eight units. The largest of these assemblies may contain as many as 16 separate valves. Kenyon Instrument Company, Inc., Huntington Station, N.Y.

Sealer for Wooden Aircraft

The product known as Aero-Rez is offered as a new synthetic resin sealer to meet Army Air Forces Specification No. AN-217. It is made especially for manufacturers of wood planes or gliders and is a companion product to Laux Rez synthetic resin sealer and primer. It can be applied by brushing, spraying or dipping, according to specifications laid down by the contractor.

This clear, transparent sealer is applicable directly to plain or filled wood and serves either as a complete interior finish or as an undercoat for lacquer and enamel finishes. It has properties of air drying and is suitable for force drying at temperatures not to exceed 150°F. The maker states that Aero-Rez has good leveling properties and, when applied to resin-bonded plywood, penetrates the wood and does not form a glossy surface. It does not contain ingredients that are toxic under normal conditions of usage. This product may also be used as a vehicle for making an aluminum pigment type of paint to specification No. AN-TT-A-461. I. F. Laucks, Inc., Seattle, Wash.

Marman Clamps

Marman clamps are designed for all types of duct and hose installations for hot or cold gases or fluids under either low or high pressure. The makers state that the clamps hold with positive, equalized circumferential tension around any convex surface and remain tight under pressure, stress, vibration, and exposure to fire or weather. Any amount of even pressure may be quickly attained with a turn of the wing nut by hand. Marman Products Company, Inglewood, Calif.

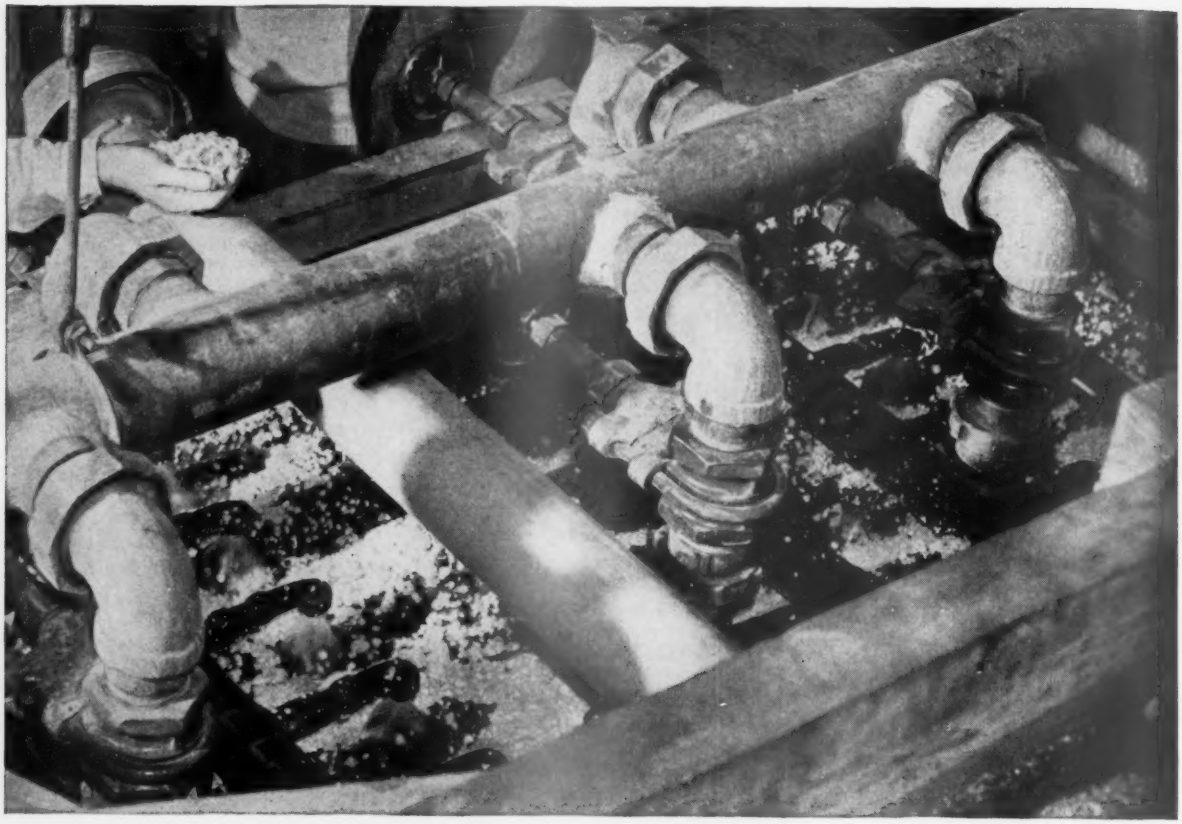
Automatic Alarm System

The Megard Mechanical Guardsman is described by the maker as an electro-mechanical system of plant boundary protection. It is claimed that it detects tunneling efforts in certain types of soil formation.

The system consists of electromagnetic generators of weatherproof construction which act as interceptor units. These are installed on the fence or barrier at uniform spacing of 50 to 100 ft. and wired to locator units. The locator units are connected to audible and visual signals in a central control station.

Any continued tampering with the barrier, such as cutting the wire, pressing against it, or climbing over it, sets up vibrations that are picked up by the interceptors and signaled to the control station.

Thrown stones, wind-blown weeds, roosting birds, expansion and contraction, or other instantaneous accidental impacts or pressures are filtered out so that false alarms are minimized. The Megard Corporation, Los Angeles, Calif.



OUT OF THESE FLOCS MAY COME THE FUTURE OF THE WORLD

These white crumbs or "flocs" look very unimportant in themselves . . . but on them may depend the future of the world. They are one of the first stages in the production of synthetic rubber, the most vital material being produced in America today.

Naturally, you are interested in synthetic rubber. But synthetic rubber is only incidental. What is really important is what happens to synthetic rubber after it is actually produced. It is chemistry that makes rubber fit to use, suits it to the task at hand.

United States Rubber Company is the largest manufacturer of rubber chemicals in the world. We have worked with rubber, improved it and broadened its uses for 100 years. Today, all this tremendous fund of knowledge of the chemistry of rubber is being drawn upon to improve synthetic rubber, perfect it for the jobs it must do for the Armed Forces and war industry.

The chemistry of rubber is what determines the final compounding and processing of the flocs of synthetic rubber you see here. They may eventually go into bullet-sealing hose, air ducts, or any one of a score of other parts used in the plane that will blast the last Nip carrier off the sea. They may be made into a tire that will rumble down bomb-battered Unter den Linden. They may go into some essential equipment like a conveyor belt that will keep America's war production line moving at top speed. They might very easily determine the entire course of the war, and thereby the future of the world.

Synthetic rubber, its production, compounding and application to war and industrial uses, is too big a story to present adequately here. There are five basic commercial types of synthetic rubber. Each of them has distinct properties and characteristics. Not a single one is ideal for all purposes.

Deciding which synthetic rubber to select and use for a particular task is an equally big story, a decision that requires expert knowledge and broad range experience.

We have told the story of the five basic commercial types of synthetic rubber, our more than twenty years of experience in working with them, and our twelve years of using synthetic rubber commercially in an interesting, informative booklet for business executives. Please ask for your copy on your regular business letterhead.

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE, ROCKEFELLER CENTER, NEW YORK

In Canada: Dominion Rubber Co., Ltd.

Miniature Bearings

Bulletin 43 describes a line of radial- and pivot-type bearings ranging in size from $^5/_8$- to $^5/_{16}$-in. outside diameter in both steel and beryllium. The double-spread tabulation gives dimensions and load ratings at varying speeds for each size and type of bearing. Illustrations are in actual size.

These bearings were designed and developed for precision industrial equipment. They are used by instrument makers, industrial laboratories, aeronautical plants, and radio manufacturers. Miniature Precision Bearings, Keene, N.H.

Welding-Rod Processing Exhibit

The Moslo welding-rod processing plant, being demonstrated at a special exhibition in Cleveland, is claimed to be the first showing of such a plant, complete from cutting machine to packaging, under a single roof.

The process starts with a wire straightening and cutting machine. Then the continuous production line begins with an automatic machine for lining up and feeding rods at high speed to an extrusion press where the special flux is forced at high pressure through a steel die to coat the rods completely. The coated rods are conveyed to a brushing machine that performs the operation of brushing a clean contact area on one end of each rod. From there the coated rods move on another conveyer into a long drying oven in which the flux is baked on, traveling several hundred feet through several elevations of heat channels.

Emerging from the delivery end of the oven, the rods are conveyed to an inspection and weighing table. The final stage is automatic packaging. Several additional units are incorporated in the complete processing plant, including a machine for mixing flux and a press for forming the "slugs" of flux which provide exactly the right charge for the extrusion press to coat each rod. Moslo Machinery Company, Cleveland, O.

Aircraft Cylinder Stand

The manufacturers of the Clayborne aircraft and automotive engine stands have made an addition to their line of engine handling equipment—the Clayborne cylinder stand for assembly and overhaul of aircraft-engine cylinders.

In the standard model the long cylinder box contains nine openings to receive cylinders, each with a pair of clamps to lock in the cylinder and hold it in rigid position. The entire cylinder box may then be rotated to any desired position to secure complete access for valve assembly. The cylinder stand is available in both portable and stationary models. Motor Rebuilding Specialties, Chicago, Ill.

Portable Engine Heater

Announcement is made of the availability for commercial use of a self-contained, self-powered, portable heater. This heater was originally developed and manufactured for the armed forces for a variety of applications, the principal use being the preheating of airplane engines in cold climates and the heating of maintenance shelters and other types of portable buildings.

The device is available in a model that uses gasoline for engine and heater fuel or in a model that uses gasoline for engine fuel and No. 2 fuel oil as a heater fuel. A small gasoline engine mounted as an integral part of the unit drives a pressure-type propeller fan that blows air over the combustion chamber and out through two 12-in. diameter openings in one end of the unit. The same engine drives a small centrifugal fan that provides air for combustion. Canvas ducts are used to convey the heated air to the location where heat is required.

Heating capacity is 250,000 B.t.u. per hour at 60° inlet. The unit is approximately 26 in. wide, 56 in. long, and 42 in. high and its weight is about 290 lbs. without ducts. It is equipped with two retractable wheels to facilitate portability. The Herman Nelson Corporation, Moline, Ill.

Operations Sequence Marker

A system of marking parts in process so that a glance reveals the complete history of that part through the various manufacturing operations and inspections has been adopted for certain products by one of the aircraft parts manufacturers. The basis of the system is an "operations sequence" marker.

This marker is a hand stamp carrying a number of consecutive numerals, the number of numerals being the same as the number of operations for which inspection is required.

Each inspector is assigned a stamp carrying a specific letter of the alphabet. Night- and day-shift inspectors may be distinguished by different borders around the letter. After each operation the inspector involved marks the part above or below the numeral corresponding to the operation he is checking. If he passes the part he puts his mark below the numeral. If he rejects it, he puts his mark above the numeral. Then when the operation is performed correctly and the part becomes acceptable, he places his mark below the numeral. Thus not only is the fact recorded that the operation has been rejected, then subsequently passed, but a record is made of both the unsatisfactory manufacturing operation and by whom it was rejected. Other checks can be worked out for specific operations and inspections by using this method of marking. New Method Steel Stamps, Inc., Detroit, Mich.

Welding Library

A new library on welding, believed to be one of the most extensive in existence, has been established at the Ohio State University. Known as the "A. F. Davis Welding Library," it is the gift of A. F. Davis, Vice-President and Secretary of The Lincoln Electric Company.

Making available in one place all important literature on welding, the library is expected to be of special value to industrial designers, engineers, technicians, and others interested in research or general information on the various forms of welding and their application to design, construction, manufacture, or maintenance of metal products and structures. Students in the university's course in welding engineering will also have the benefit of using the library.

Although in its early stage of development, the library already contains over 700 books. Included are those on metallurgy, designing for welded construction, welding techniques and procedures, properties of weld metals, standard welding handbooks, bound volumes of welding magazines, the award studies of The James F. Lincoln Arc Welding Foundation, patents relating to welding, and many other subjects. The library is located in the Industrial Engineering Building which houses the Welding Engineering Department. Ohio State University, Columbus, O.

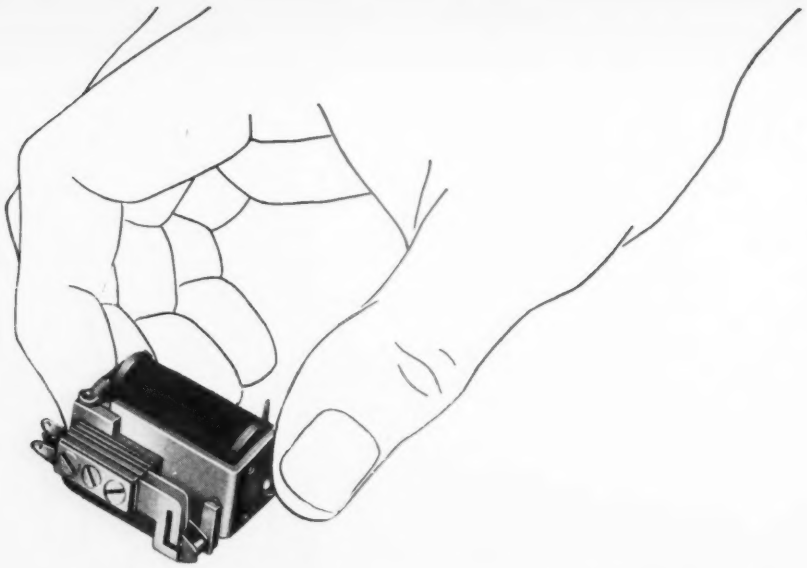
Floating Air Bases

Plans have been completed for the establishment of a series of seadromes to be anchored at intervals across the Atlantic Ocean to serve as floating bases for a proposed commercial air line to Europe.

They are described as islands of steel which will stand 70 ft. above the ocean surface, having a draft of 160 ft. below the surface, thereby being expected to remain practically motionless and be unaffected by rough surface water. Each unit would provide complete airport facilities for landing, taking off, refueling, such service and maintenance work as might be required, and accommodations for passengers including a hotel and restaurants. These seadromes would be located at intervals of about 800 miles and outside of the zones of fog and bad weather. Pennsylvania-Central Airlines.

New Piper Trainer

A new model multipurpose training plane has been developed from the Piper Cub J-3 trainer and designated as the Piper PT. At present it is powered by



TINY... BUT PACKED WITH POWER

SMALL size and light weight are only part of the story behind Automatic Electric's new Class "S" Relays. Designed to meet the punishing conditions of operation on the fastest modern aircraft, they offer a combination of features never before found on any relay, large or small. Here, for example, are three of the many basic improvements in these tiny but powerful relays:

FIRST: Resistance to vibration has been built-in—not "added on." The most searching scientific tests fail to reveal false contact operation even under vibration conditions far beyond the limit of human endurance. Class "S" Relays withstand, with a substantial margin of safety, the most rigorous operating tests required for aircraft relays by the Signal Corps and the Air Corps.

SECOND: Maximum contact dependability is provided through a unique type of spring design, which provides high contact pressure within small space limits. Independent, self-cleaning twin contacts provide additional safeguards.

THIRD: A new type of pin pivoted armature with full length bearing provides exceptionally long life under severe service conditions.

For the complete story on Class "S" Relays, write for the engineering data sheets, giving full specifications:

AMERICAN AUTOMATIC ELECTRIC SALES COMPANY
1033 West Van Buren Street, Chicago, Ill.

Class "S" Relay—Single Arm

Class "S" Relay—Double Arm

Class "S" Relays are available with a wide variety of coil and contact combinations and operate and release speeds. The single arm relay has a capacity of six contact springs—the double arm, twelve springs. Springs may be provided in any combination and arrangement of "break," "make" or "break-make" assemblies.

Relays
AND OTHER CONTROL DEVICES
by AUTOMATIC ELECTRIC

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

a Franklin 130-hp., six-cylinder, horizontally opposed engine, and provision is made for a more powerful engine if required.

The new plane utilizes a modified version of the airfoil section used on earlier Piper trainers, being the USA 35B15 at the root and 35B10 at the theoretic tip. For more advanced transitional training the plane is equipped with N.A.C.A. slotted flaps, in addition to which it has retractable landing gear. Provision is made for the optional use of the landing gear as a fixed or retractable unit, depending upon the instruction to be given. In the present model the retracting mechanism is operated by hand, but later models can be equipped with electrical operation.

The plane may be flown solo from either the front or rear cockpits, which have identical equipment. In addition to the primary controls, each cockpit includes the following controls and instruments: flap control, parking brake, gear retracting mechanism control, wobble-pump, starter, carburetor heat, cabin heat, fuel selector valve, air-speed indicator, bank and turn indicator, rate-of-climb indicator, altimeter, clock, compass, tachometer, oil thermometer, fuel pressure and oil pressure gauge. Fuel gauges, easily visible from either cockpit, are on each wing directly above wing tanks. Navigation lights are installed as standard equipment and, for night flying, provision is made for the installation of landing lights and flares. For instrument training an auxiliary panel is installed above the standard rear panel attached to the nose-over structure. This panel includes the remaining blind-flight instruments necessary, as well as radio equipment that can be operated from either cockpit.

Adjustable rudder pedals, as well as adjustable seats, are installed for the accommodation of pilots of varying heights. The cockpits are hatch-enclosed, the enclosure being so designed that both side window sections may be lowered.

Nonstrategic material has been used wherever possible in the construction. The fuselage is a conventional steel tubular Warren truss construction, with integral nose-over structure located between cockpits. The No. 1 bulkhead includes fittings for attachment of the engine mount by four bolts. Wood stringers are used throughout and the turtleback is of plywood construction, the combination giving the fuselage a general elliptic section.

Wings are full cantilever, built-up, box-type monospar with wooden ribs. They are composed of a center section and two outer panels joining outboard of the landing-gear attachment. An auxiliary rear spar carries the aileron and flap brackets. The wings have a two to one taper ratio with 6° dihedral and enough washout (twist) to avoid unfavorable stall characteristics. The center section carries, in addition to the landing gear and retracting mechanism, two stainless steel fuel tanks having a total capacity of 40 gal. Wings are covered with $^3/_{32}$-in. mahogany diagonal plywood. This is, in turn, covered with fabric to facilitate standard finishing procedures and to protect the surface against the elements.

Fin and stabilizer are plywood and fabric covered and are of full cantilever construction. Rudder and elevator are fabric covered as are the other movable control surfaces.

Specifications and performance data are as follows: power—Franklin 6 AC 298, 130 hp., horizontally opposed; maximum speed—over 150 m.p.h.; cruising speed—over 135 m.p.h.; landing speed—under 50 m.p.h.; rate of climb—750–1000 ft. per min., depending upon propeller used; cruising range—700 miles; empty weight—1,325 lbs.; useful load—675 lbs.; gross weight—2,000 lbs.; wing span—34 ft.; length overall—22 ft., 10 in.; height overall—6 ft., 6 in.; wing area—164 sq.ft.; wing loading—12.2 lbs. per sq.ft.; power loading—15.4 lbs. per hp.; aileron area—15.4 sq.ft.; flap area—13.8 sq.ft.; stabilizer area—15.2 sq.ft.; elevator area—12.2 sq.ft.; fin area—5.9 sq.ft.; rudder area—5.8 sq.ft.; fuel capacity—40 gal. Piper Aircraft Corporation, Lock Haven, Pa.

Aircraft Radio Test Chamber

An altitude test chamber for aircraft radio and electronic equipment in which engineers can see the entire apparatus in operation under conditions simulating stratosphere conditions at a height of $7^1/_2$ miles has been developed. This chamber, constructed from the transparent nose cone of a bomber, is built of Plexiglas. Because of the transparent construction, it makes possible the complete testing and inspection of any piece of radio apparatus by several engineers at one time and materially speeds test work. The construction is reported to have advantages over test chambers that are constructed of metal and permit vision only through small portholes. An entire complement of test instruments and meters may be connected to the apparatus under test and plainly viewed by the project engineers.

The chamber is cone-shaped, about 4 ft. high and 5 ft. in diameter at its base. An airtight seal is accomplished by fitting a heavy platform, arranged for mounting radio apparatus under test, with a ring of soft rubber. The test chamber cone is then lowered until its base rests on the rubber ring. As the air is withdrawn by a suction pump, the atmospheric pressure on the outside of the chamber forces it down into the rubber ring and creates a tight air seal. R.C.A. Victor Division of Radio Corporation of America.

Three-Inch Oscilloscope

Design has been completed of the Model 553, 3-in. cathode-ray oscilloscope to fill the need for an extended frequency oscilloscope with improved sensitivity. Its construction and low power consumption make it suitable for use as a portable field instrument. All controls and terminals are located on the front panel. The switching arrangement permits applying input either directly to deflection plates or to the input of the amplifier. Position and stable locking of the image can be obtained with either the vertical signal or any external signal. The amplifiers use television tubes for maximum sensitivity.

General specifications are as follows: power supply—110 to 120 volts, 50 to 60 cycles; power consumption—50 watts; input impedance through either amplifier—1.5 megohm, 20 micromicrofarads; without amplifier—2.2 megohm, 40 micromicrofarads; deflection sensitivity through either amplifier (maximum gain)—0.6 root-mean-square per in.; without amplifier—35 roote-mean-square per in.; amplifier frequency response (±3 db.)—20 to 100,000 cycles; linear time-base frequency range—15 to 22,000 cycles; synchronizing signal sources (internal)—60 cycles. Radio City Products Company, Inc., New York, N.Y.

Plexiglas Tests

The makers of Plexiglas have issued a report on the thermal relaxation of formed Plexiglas parts. The experiments were made in order to establish relations between the conditions of forming sections of this material and their subsequent ability to withstand various service temperatures without deformation.

The test specimens are described, as well as the methods followed in the investigation. The information resulting from the tests is tabulated and text matter explains the results achieved.

The conclusions reached were as follows: (1) The study shows that the lower the forming temperature, the higher the stress necessary to produce a given strain and, hence, the greater the rate of relaxation at any given service temperature; (2) in order to be able to say how fast a formed section would relax at any given temperature, it would be absolutely necessary to know as accurately as possible what the temperature of the sheet was when the stress was applied. Not only the temperature of the forming oven but an accurate record of the time that the

A WORD TO THE CREW OF A BOMBER

Delco-Remy
Aircraft Electrical Equipment

With the sky as your battlefield, you have learned to conquer time and space. You have lifted your own and America's eyes to new horizons, and prepared this nation to make full use of the very air you are making free. ¶ Delco-Remy electrical equipment is used today in heavy and medium bombers. In days to come, it will be applied to meeting the requirements of commercial planes, while smaller Delco-Remy units will provide the convenience and dependability of electric starting, lighting and ignition for private planes. ¶ Delco-Remy's qualifications for serving the aviation industry are implicit in this fact: More than half of Delco-Remy's facilities are now engaged in the manufacture of aircraft electrical units, precision parts and products.

DELCO-REMY

DIVISION, GENERAL MOTORS CORPORATION

sheet remained exposed to room temperature air before the actual stretching was completed would be necessary. Rohm & Haas Company, Philadelphia, Pa.

New Air-Speed Control Developed by Ross

An air-speed control valve has been designed to provide and maintain accurate split-second timing of piston movements.

It is stated that starting with full capacity flow in both directions, the flow in one direction can be controlled over a wide range to a completely closed position. A greatly increased range of selective speeds is obtained through a vernier-like adjustment mechanism. A specially designed stem and floating bevel seat poppet maintain a positive steady control at any selected speed. Ross Operating Valve Company, Detroit, Mich.

Noncritical Plastic from Redwoods

A new noncritical phenolic type thermoplastic, chemically derived from the phlobaphenic structures of the redwoods, is now available for both war and civilian production of items formerly manufactured from hard rubber and other thermosetting plastic compounds.

The new redwood plastic embodies in one composite form both resin and filler employed in the molding of a variety of products. It is claimed to be readily adaptable to either compression molding or the standard equipment of hard-rubber plants. When special properties are desired it can easily be mixed with other resins and plasticizers. For ease in identification the new plastic has been called "Shellerite."

The discovery of this new plastic is credited mutually to The Pacific Lumber Company, San Francisco; The Institute of Paper Chemistry, Appleton, Wis.; and the Sheller Manufacturing Corporation, Portland, Ind. These organizations correlated and financed the research necessary before the plastic was finally perfected and ready for commercial use.

It was found that redwood trees produce catechol tannin, a soluble element which, in the processes of nature, is converted into insoluble phlobaphenes. When redwood is reduced to chips and subjected to a short cycle of high-pressure steam, the phlobaphenes within the cell structure are reacted. After being defiberized, the resultant fiber or powder produced therefrom becomes the thermoplastic substance. Sheller Manufacturing Corporation, Portland, Ind.

Aircraft Circuit Breaker

Supplementing the line of Class 9300 aircraft circuit breakers which had a maximum capacity range of 5 to 70 amp., the makers have announced a new breaker development in capacities of 80, 90, 100, and 125 amp. at 30 volts d.c.

Primarily designed for aircraft, the nontrip free, vibration-proof and lightweight factors of these circuit breakers make them suitable for use in tanks, boats, and other mobile equipment. The combination of toggle switch and circuit breaker in a single sealed unit is reported to save weight, space, and wiring time.

These breakers may be used for direct control of electric motors, lighting circuits, communication and signal systems, or fire-control installations. Each breaker is calibrated and factory sealed; no field adjustments are necessary.

They have been vibration tested in accordance with Air Corps specifications. The design includes provision for proper operation when subjected to ambient temperatures of from −50° to +135°F. With ample overload capacity a circuit may be maintained in an emergency due to the nontrip free construction. Square D Company, Regulator Division, Detroit, Mich.

Welding and Brazing Fluxes

Four new welding and brazing fluxes have been produced primarily for the aircraft industry and its suppliers.

Superior No. 6 is a nonacid silver solder paste flux that is reported to contain no free hydrofluoric acid and can therefore give off no hydrofluoric acid fumes. No. 7 is a flux designed especially for the torch welding of stainless steel and similar chrome, nickel steel alloys. It is claimed to have unusual penetrating qualities and a low melting point.

Superior No. 8 is an Inconel torch-welding flux produced primarily for the torch welding of such airplane parts as mufflers and exhaust manifolds made of Inconel metal. This flux has good wetting and penetrating qualities and successfully scavenges the oxides created during the welding procedures. No. 9 is an aluminum torch-welding flux, intended for the welding of both sheet and cast aluminum and its alloys. It also serves successfully on magnesium. The flux makes welds with deep penetration and free from aluminum oxides. It has good wetting qualities and is rapid in operation.

All of these fluxes are reported to meet U.S. Navy and Army Air Corps specifications. Superior Flux Company, Cleveland, O.

Shear-Hardness Tester

A new shear-hardness attachment for the Taber abraser provides a method for measuring the toughness quality of surface finishes and their ability to resist scratches and similar abuse resulting from actual service but not considered normal wear.

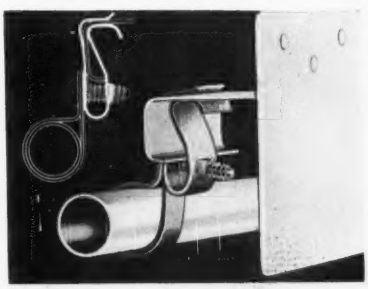
A weight slides along the calibrated beam until it is finally located in the position where the correct load permits the tool point to cut a groove in the surface finish without digging through to the base plate. Several grooves are made in the surface and the most representative one is selected to measure to the nearest thousandth of an inch. A special Taber micrometer is furnished to make the measurement. The shear-hardness of the specimen is calculated by taking the reading from the calibrated beam at the forward edge of the adjustable weight which, together with the width of groove, determines the result by a mathematical formula. A small 4-in. square sample is required to make this test.

In addition, the maker claims that the abraser accurately evaluates resistance of surface finishes to rubbing abrasion. Scientific wearing action by "Calibrase" wheels on a specimen clamped to a revolving turntable is measured in terms of "wear cycles" that are automatically totaled on the built-in counter. The Taber Instrument Corporation, North Tonawanda, N.Y.

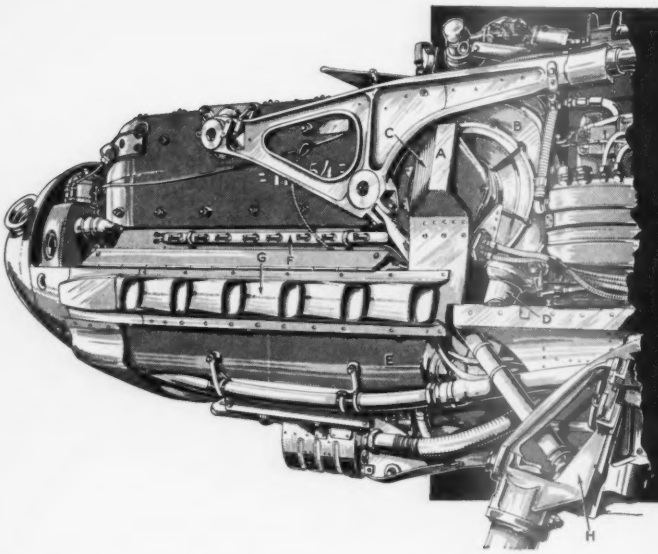
Aircraft Speed Nut for Rolled Sections

To meet the present trend toward more widespread use of rolled sections a new Speed Nut has been developed for rapid assembly of conduit, piping, and wire harnesses in aircraft.

Speed Nut No. 6337 is made of special aircraft spring steel with a zinc metal spray finish. It is designed to snap around rolled sections or stringers and to eliminate the need of drilling holes which weaken the structure. As the screw in the Speed Nut is tightened the two legs are forced inward to give a firm spring tension grip. The nut is made for 8Z and 10Z sheet metal screws



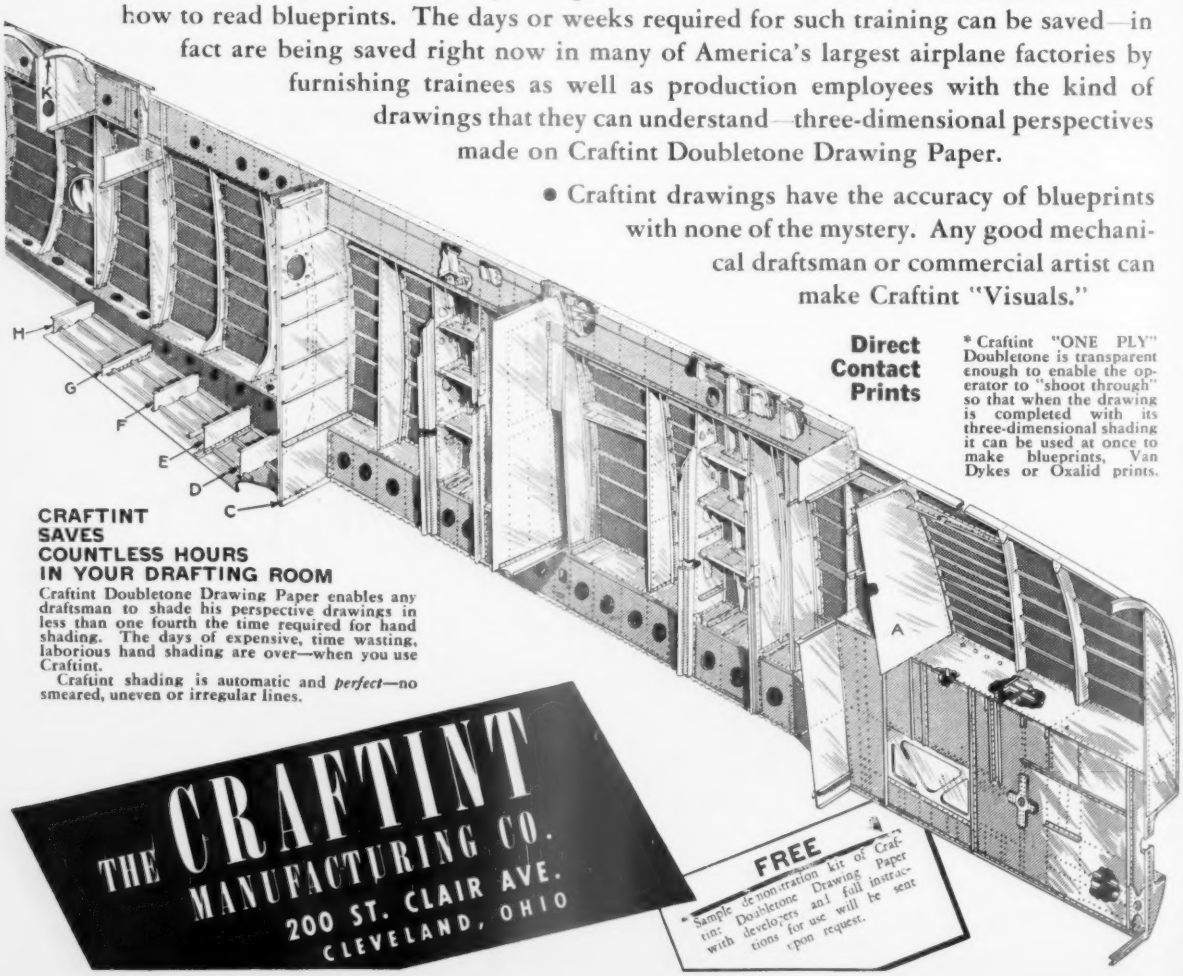
The Tinnerman aircraft speed nut for rolled sections.



CRAFTINT PERSPECTIVE DRAWINGS

are speeding aircraft production

- The tremendous expansion of the aircraft industry means the constant training of thousands of new workers. It is vitally necessary that training periods be both rapid and thorough.
- Shortening the time required to teach new workers is an important step toward winning the war. Every hour saved brings us just that much closer to Victory.
- For instance, no longer is it necessary, except in isolated instances, to teach aircraft workers how to read blueprints. The days or weeks required for such training can be saved—in fact are being saved right now in many of America's largest airplane factories by furnishing trainees as well as production employees with the kind of drawings that they can understand—three-dimensional perspectives made on Craftint Doubletone Drawing Paper.
- Craftint drawings have the accuracy of blueprints with none of the mystery. Any good mechanical draftsman or commercial artist can make Craftint "Visuals."



Direct Contact Prints

* Craftint "ONE PLY" Doubletone is transparent enough to enable the operator to "shoot through" so that when the drawing is completed with its three-dimensional shading it can be used at once to make blueprints, Van Dykes or Oxalid prints.

CRAFTINT SAVES COUNTLESS HOURS IN YOUR DRAFTING ROOM

Craftint Doubletone Drawing Paper enables any draftsman to shade his perspective drawings in less than one fourth the time required for hand shading. The days of expensive, time wasting, laborious hand shading are over—when you use Craftint.

Craftint shading is automatic and *perfect*—no smeared, uneven or irregular lines.

FREE

* Sample demonstration kit of Craftint Doubletone Drawing Paper with developers and full instructions for use will be sent upon request.

THE CRAFTINT MANUFACTURING CO.
200 ST. CLAIR AVE.
CLEVELAND, OHIO

and designed for use on various sizes of "Z" stringers. A similar Speed Nut, No. 6320, is made for beaded extrusions. Tinnerman Products Inc., Cleveland, O.

Vertical Type Twelve-Spindle Automatic Screw Machine

The Eaglesfield Verti-Matic is a hydraulically operated, twelve-spindle, vertical-type automatic bar feed and chucking screw machine. Designed primarily for the fast and accurate production of parts from round, square, or hexagon bar stock, the Verti-Matic may also be used for the machining of drawn steel parts of different shapes. Many adaptations are possible. For instance the machine can be used, without changing, for chucking operations within its capacity, as the weight of the parts in the long magazine tubes automatically discharges the finished pieces.

Among the advantages claimed for the machine are faster production with less man power, simpler and faster setup because of pretool setup at the bench, and 50 per cent less floor space requirement because of the vertical construction.

While the machine provides twelve different operations for completing a part, it also permits the employment of duplicate operations to produce more than one piece at the same time. For example, if a part can be made in six stages of the turret, two pieces can be made at the same time by tooling the six in duplicate. If a part can be made in four stages, three parts can be made at one time. Where the part can be completed in one position by using the tools on both horizontal and vertical cylinders, the turret is held in one position and twelve parts are made at the same time.

The machine is composed of two units—the machine proper and the control unit. Being vertical in design, there are no long lengths of bar stock to project horizontally from the machine. In addition to the saving of floor space, mechanical contrivances used to feed the stock are eliminated, since the feeding is handled entirely by gravity through the hollow spindle from above. It is stated that the unit can be operated and tooled by the average good mechanic.

The Verti-Matic is operated entirely by Hydraulic timing, which is adjusted by the setting of split cams to obtain the timing desired. The camshaft is driven by an adjustable V-belt pulley, making it possible to obtain any timing cycle. This timing enables the indexing to be done without shock, and three minor adjustments permit any wanted variation in the operating cycle. The tool feed speed is adjusted with an all-steel valve for each cylinder, located under the cylinder. A direct-connected pump forces cooling oil to the manifolds. The coolant volume is great enough to wash the chips down the gravity chute in the bottom of the oil covers into the chip box, which is easily emptied when filled. As the machine is designed for water soluble coolants, there is no destructive heating of tools and work. The C. I. Togstad Company, Machine Tools Division, Kokomo, Ind.

Bright Zinc Plating Methods

A 14-page mimeographed technical report on bright zinc plating as a substitute for cadmium plating gives descriptions of still and barrel plating, using a choice of three precleaners, Turco Penetrol, Supertrol, or Composition L-570 and, as the final cleaner, Turco Porokleen.

Because the supply of cadmium is now critical, cyanide zinc plating is replacing cadmium plating in many industries, according to the report. The new zinc cyanide baths have a relatively high throwing power, provide a corrosion-resistant plate claimed to be as effective as cadmium, and produce a bright plate. Which of the three precleaners are used depends upon plant facilities, the type of work to be cleaned, and other operating conditions. Porokleen, the final cleaner for plating, can be used either in a still tank or in electrocleaning. Both methods are outlined in the report. Turco Products, Inc., Los Angeles, Calif.

Washer for Oil Temperature Regulators

The Turco Surge Washer has been developed for cleaning aircraft oil temperature regulators. The washer is claimed to clean two oil regulators simultaneously, replacing the method whereby radiators were cleaned at overhaul centers by pumping solvent through them and flushing. It operates by a cleaning solution pumping mechanism, so designed that a reversal of flow is obtained many times every minute. The pump produces a surging action that pushes and sucks the cleaning solution through the interiors while the regulators are constantly being turned and tumbled so that the churning solution is sloshed into every pocket and crevice of the unit. This continual forceful motion was designed to dislodge the sand, heavy metal particles, and other insoluble materials that are then carried out by the current.

Two fine-screen baskets catch heavy residues and metal particles washed out of the regulators. By examining their contents the operator can determine what parts are wearing and other indicative facts about engine conditions.

Turco Penetrol is the solution used in the machine to remove surface soil in the radiators, emulsifying oily and greasy deposits, and deflocculating carbon.

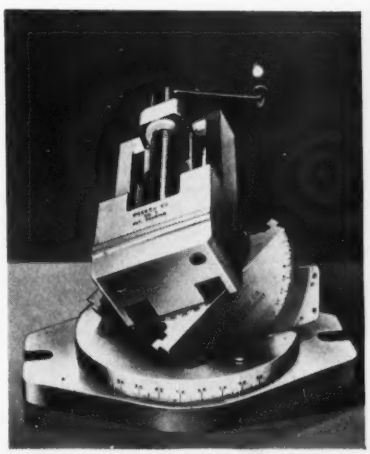
The machine consists of a 42-gal. steel tank, which acts as a reservoir for the Penetrol solution, a $^1/_3$-hp. motor and speed reducer, two pivoting cradles to hold the radiators, and a ratchet-and-pawl mechanism to revolve the cradles. A single-cylinder surge pump forces the solution through the radiator and then draws a small amount back with each stroke. A gate intake valve is actuated by an eccentric on the main drive shaft. When the cleaning operation is completed, air pressure clears the solution from the regulators. Turco Products, Inc., Los Angeles, Calif.

Vise and Angle-Plate

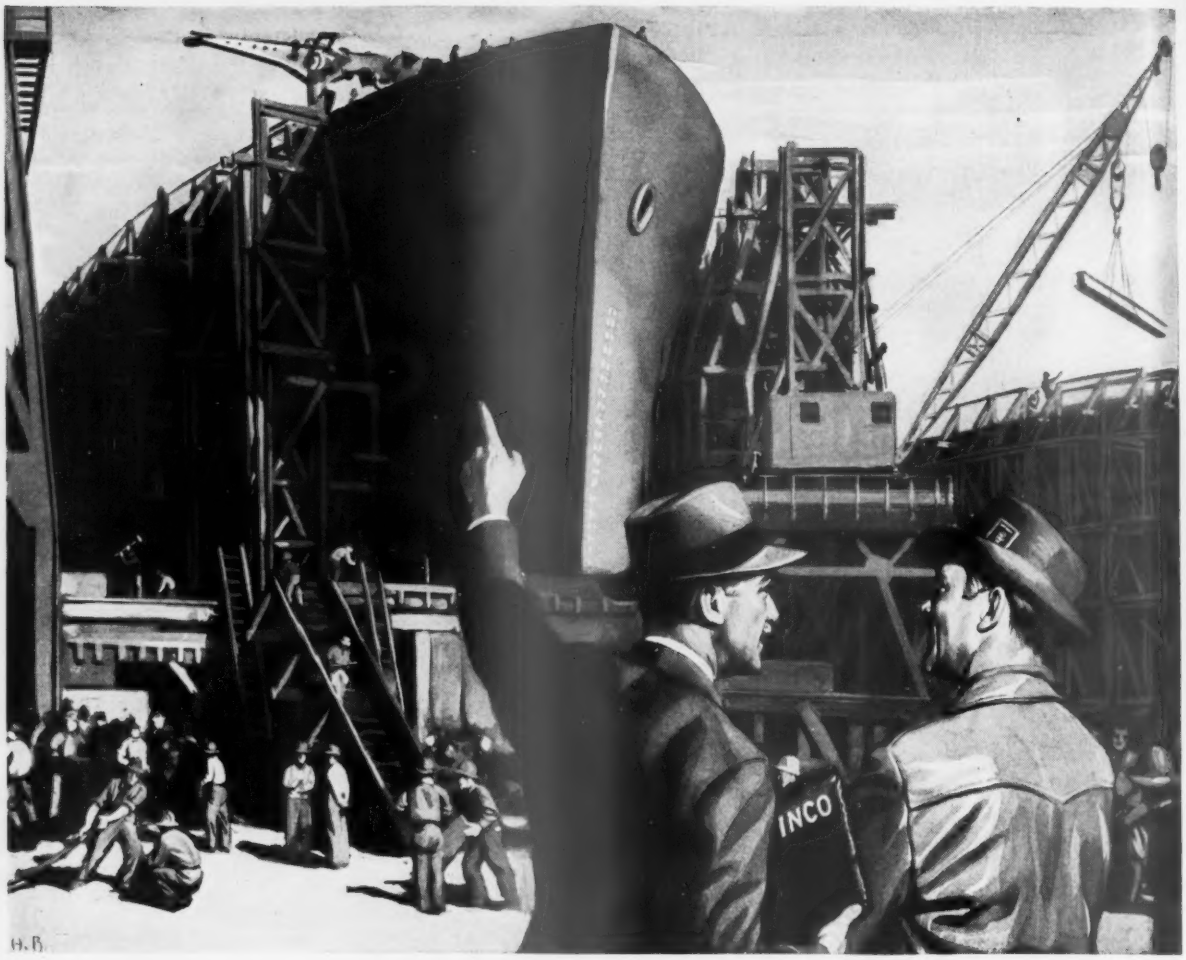
The Wesson universal vise is designed to be mounted on a machine tool for angle machining operations. It permits angle milling, drilling, grinding, boring, reaming, slotting, buffing, tapping, honing, spot facing, counterboring, lapping, superfinishing, grooving, planing, shaping, die-sinking, and other machining operations involving angles, with accuracy at high production speeds. It is portable and may be moved from one machine to another without disturbing the angle or removing the work, thus permitting a series of angle operations at the fixed angle required.

The vise swings through 180° in the top plane, 90° in the vertical plane, and 360° in the bottom plane and is completely graduated in all planes. Vernier graduations, for use where extreme precision is required, are available at additional cost.

The vise is made in two sizes, one having a jaw-opening up to 4 in., being $6^1/_8$ in. high overall, and the other having jaw-opening up to $1^3/_8$ in., being $4^3/_8$ in. high overall. Wesson Company, Detroit, Mich.



The Wesson universal vise.



NICKEL AIDS THE MARINE INDUSTRY

to KEEP 'EM SAILING!

"Uncle *Needs* His Ships." That sign in a shipyard, a thousand miles from the sea, typifies the fighting spirit of America's ship builders. These men will turn out new tonnage faster than Axis bombs and torpedoes can sink it.

In peacetime, their engineering-thinking created efficient power plants that pushed ships of commerce through the seven seas. They designed propelling machinery—turbines, valves, pumps and gears—to move the ship and intricate instruments to guide and guard it on its important mission.

From turbine rotors to propeller shafts, from reduction gears to condenser tubes, those engineers relied upon ferrous and non-ferrous alloys strengthened and toughened by additions of Nickel. They used the properties of Nickel to fight corrosion and fatigue.

During wartime, when uninterrupted operation of America's bridge of ships means so much, the continued and widespread use of Nickel is convincing evidence of its many advantages. Now that sea-going metals must withstand repeated demands for stepped-up performance, a little Nickel goes a long way to insure utmost dependability.

Marine engineers and designers have long known and builders and fitters... as well as repair crews at bases 'round the globe... are learning that, properly used, a little Nickel goes a long way to "keep 'em sailing."

For years the technical staffs of International Nickel have been privileged to cooperate with the men who build and operate ships of all types. Counsel, and printed data about the selection, fabrication and heat treatment of Nickel alloyed materials, is available upon request.

★ **Nickel** ★

Send for lists of available publications. Address your inquiries to Technical Library Service

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall St., New York, N. Y.*

Institute News

Burden Elected Chairman of War Aviation Committee

The Civil Aeronautics Administration has announced the election of William A. M. Burden, Special Aviation Assistant to the Secretary of Commerce, as Chairman of the War Aviation Committee.

The committee, which is the final authority on air traffic problems, is composed of Robert A. Lovett, Assistant Secretary of War for Air, Artemus L. Gates, Assistant Secretary of the Navy for Air, and L. Welch Pogue, Chairman of the Civil Aeronautics Board. Mr. Pogue has been named Secretary of the Committee.

The committee will receive and act on important policy recommendations of the Interdepartmental Air Traffic Control Board and recommendations on which the Board does not unanimously agree, according to the procedure approved by the President and made effective April 22.

W. A. M. Burden.

Gifts to the Aeronautical Archives

Among the gifts of the month were 36 additional *R.T.P. Translations*, from the British Air Commission in Washington. The Archives collection of more than 500 of these important publications is one of the most complete in the country. A catalogue of the *Translations* is published in this issue on page 117.

Simmonds Aerocessories, Inc., gave a colored reproduction of "The Charge of the Hurricane," a painting by Hesketh Hubbard. Consolidated Vultee Aircraft Corporation presented a portfolio of seven colored airplane prints. The Brewster Aeronautical Corporation gave several colored reproductions of prints of airplanes. Carroll Frey and The Penn Mutual Life Insurance Company sent an artist's proof by Charles R. Gardner showing Blanchard's balloon ascension of 1893 in Philadelphia and a photograph of a painting by Joseph Jackson on the same subject.

A Freedman-Burnham adjustable pitch propeller was received from Gordon L. Freedman. P. Stammer gave a plate made in 1928 in honor of Col. Charles A. Lindbergh. J. C. Young sent a cloth relic of the Pacific flight of Sir Charles Edward Kingsford-Smith in the "Southern Cross" in June, 1930.

A medallion of the Fifth International Congress on Aerial Navigation was received from M. J. Thompson, of the University of Texas. Jamison Handy sent a framed copy of the well-known quotation on research by Charles F. Kettering.

John R. Cuneo gave a typewritten *History of the 13th Aero Squadron*, by E. F. Richards and S. M. Avery. Shepard Dudley sent a copy of *A Description of the Manly Engine*, reprinted from the *Langley Memoir on Mechanical Flight*. Pan American Airways and Ross A. McFarland gave copies of *Keeping Fit for Flying* and *Medical Program and Policies; Annual Medical Reports, 1941–42*, two important contributions to the literature on aviation medicine.

Mrs. Bella C. Landauer added to the great collections of aeronautical sheet music and other aeronautica previously given. The Eclipse Aviation Division of Bendix Aviation Corporation, National Aviation Corporation, and *Aero Digest* continued with gifts of duplicate periodicals. Edward R. Warner, S.

Presentation of The W. J. McGough Award of Air Service Post No. 501 of The American Legion "For outstanding efforts to make the United States more informed regarding air power," to Major Gill Robb Wilson, President of the National Aeronautic Association, by Major Lester D. Gardner, Vice Commander of the Post.

Left to right—Josh Lee, Civil Aeronautics Board; Major Gardner; Samuel F. Pryor, Jr., Vice-President, Pan American Airways; Major Wilson; Col. Carroll Cone, Post Commander; Major Gen. Ralph Royce, U.S.A.F.

Announcing

-MEGATHERM-

A RADIO FREQUENCY TOOL FOR INDUSTRY

★

The Fast, Accurate, Economical application of

ELECTROMAGNETIC ENERGY to SURFACE HARDENING . . .

The above photo shows actual test data and parts to illustrate accurate control of case depth by means of simple adjustment of heat-treat time. The above bearing surfaces were case hardened by the MEGATHERM PROCESS *after finish grinding.* There was complete freedom from warping and distortion.

We invite you to discuss your problems with us.

Manufactured by

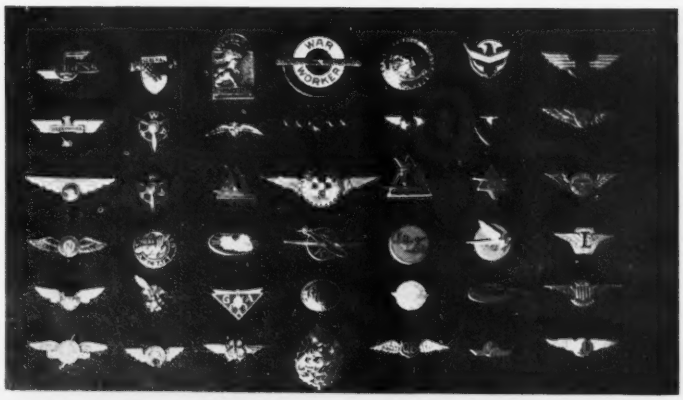
Federal Telephone and Radio Corporation

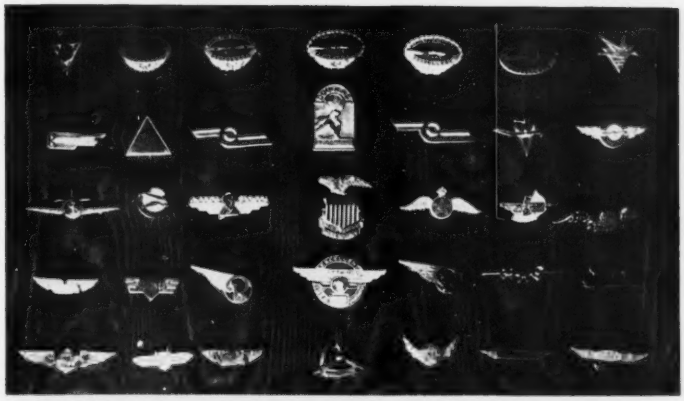
INDUSTRIAL ELECTRONICS DIVISION
200 Mt. Pleasant Avenue, Newark, New Jersey

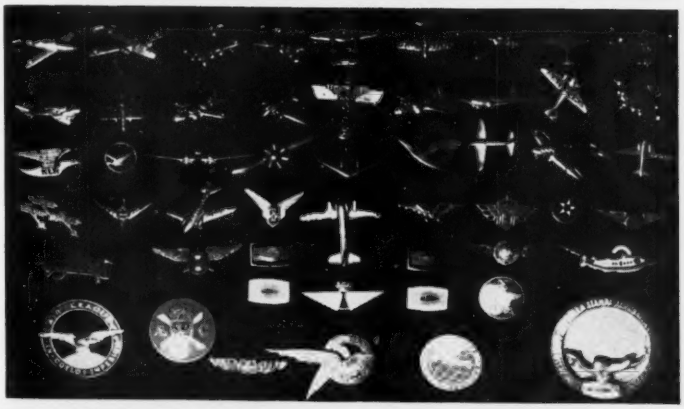
AN IT&T ASSOCIATE

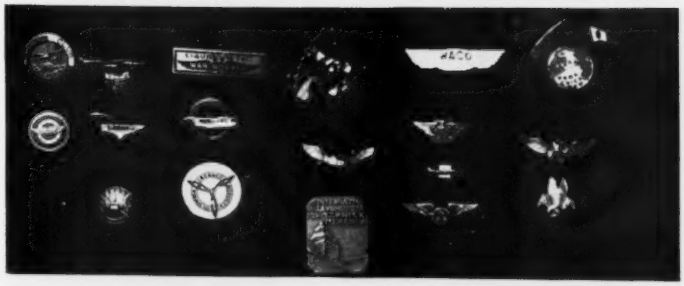
Paul Johnston, The Curtiss-Wright Corporation, and many others continued to support the Archives with gifts.

Through the generosity of many companies and individuals, the collections of insignia of aircraft companies and the armed services have expanded greatly. Reproductions on this page and on page 171 show some of the present collection. The cataloguing of the many additions is still in process. A description of the collection as a whole, together with a complete list of donors, will be given in a future issue of the AERONAUTICAL ENGINEERING REVIEW.









New Corporate Members

The following are brief summaries of the products and activities of companies that have recently become Corporate Members of the Institute:

Bausch & Lomb Optical Company has taken an active part in the development of driftsights, bubble sextants, and similar aeronautical instruments. It is also interested in lighting and illumination problems in connection with aircraft and landing fields. Its war activities in these fields have been numerous but of a confidential nature. Contacts with related industries have resulted in contributions that cover the entire range of optical measuring instruments.

In the aerial photographic and photogrammetric fields the company is best known for its work on long-focus and wide-angle lenses, as well as the development of the Multiplex equipment for accurate aerial contour maps. Other products are goggle lenses and frames of all types.

Canadian Pacific Airlines Limited. In addition to the company's primary business of air transportation, it is engaged in studying various types of aircraft particularly adaptable for the development of Canada's natural resources in regions solely accessible by air or more efficiently served by this medium of transport. Research is also being conducted on types of cargo glider units that could be used for northern air transport operation in Canada, as well as investigating the operating and pay-load characteristics of the various types of long-distance aircraft suitable for transoceanic service.

Another activity is the operation of six Air Observer Schools and five engine-overhaul and aircraft-repairing plants for the Royal Canadian Air Force as part of the war program. It has a subsidiary division known as the Aerial Surveys Division, which operates a map and photographic survey service throughout Canada.

HOW MANY PARTS OF A COMBAT PLANE *are unimportant?*

AIRCRAFT QUALITY WIRE
Every type, including stitching wire, hinge-pin wire, strut and tie wire, lock wire, cotter-pin wire, special shape wire. Supplied in carbon, alloy and stainless steels. Bright, tinned or galvanized finishes.

AIRCRAFT CONTROL AND STRUCTURAL CABLES
Assemblies and fittings.

COLD FINISHED BARS
Standard analyses in round, square and hexagon shapes.

COLD ROLLED STRIP STEEL
Stainless, carbon and alloy in widths up to 24 inches.

SPRINGS
Extension, Compression, Torsion, Flat Spiral or Motor types.

WIRE FORMS
Special formations and sizes.

WELDING ROD
Bare — carbon, alloy and stainless.

AIRCRAFT SPECIAL NAILS AND PINS

ASK a plane designer and he'll answer, "Not one."

In a fighting plane or bomber, elimination of the unessential has been carried to the ultimate limit. Every part, however insignificant, has a necessary function.

The tiny spring on a bomb bay latch, the simple gusset that reinforces a corner joint, or the bell crank on the tail control, each has a vital job to do—or it wouldn't be there.

That's why the materials we offer for airplane use are as nearly perfect as we can make them.

That is why every pound of steel destined for such applications is subjected to tireless check and scrutiny to safeguard its quality and to assure its unfailing performance in service.

It is because of this constant striving for perfection that we have been able to "come through" with the high quality of steels and steel products necessary for America's breath-taking aircraft program.

These products have found their place in America's finest planes because our chemists, engineers and metallurgists are continually searching for, and finding, new and improved ways of making them better—and our mills have the facilities to produce them in large quantities.

Here are airplane materials that have truly earned their wings. Use them with confidence.

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Export Company, New York

UNITED STATES STEEL

The Denison Engineering Company has cooperated with the Army Air Forces in the design and development of a wide variety of oil hydraulic testing equipment, both portable units for field use and stationary units for hangar use, and has manufactured such equipment, which is used for testing aircraft hydraulic systems, landing gear, propellers, automatic pilot devices, and other accessories.

In addition, it has cooperated with the Army Ordnance Department in the design, development and manufacture of automatic hydraulic presses for consolidating tracer, incendiary, and explosive loads in projectiles and of automatic hydraulic presses for reconsolidating tetrol pellets in burster tubes, for assembling shells, for black powder time fuse ring consolidation, for inserting primers in shell cases, and special tooling for these operations.

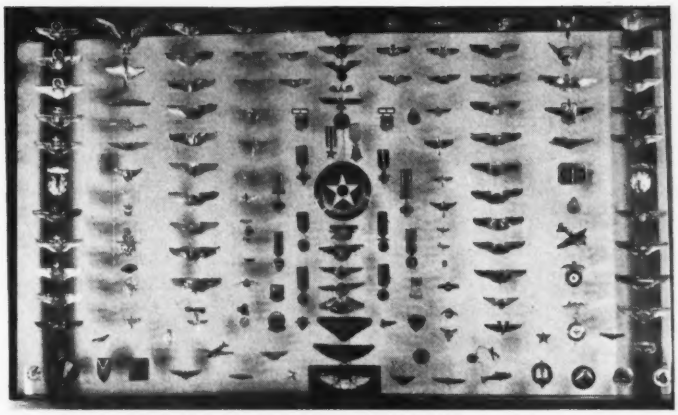
General Motors Corporation was in peacetime a leading manufacturer of motor vehicles, parts, and accessories. Prior to the entrance of the United States into the War, one division of the company manufactured liquid-cooled engines for aircraft exclusively and another division produced constant-speed propellers with steel blades.

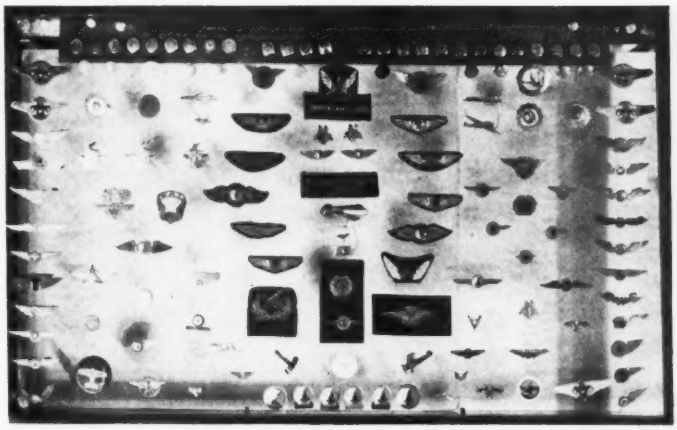
Since December, 1941, all divisions have devoted their plants to a great variety of war products, some of those being fighter and bomber planes for the Navy, bombers for the Army, liquid-cooled engines, air-cooled engines, constant-speed propellers, major sections of light and heavy bombers, automatic pilots, bombsights, spark plugs, landing struts, hydraulic controls, generators, motors, magnetos, gyroscopes, instruments, guns of various sizes, radiators, oil coolers, intercoolers, and engine starters.

Interstate Aircraft and Engineering Corporation manufactures several types of complete airplanes and various mechanical, electrical, and hydraulic accessories. Prewar airplane production was entirely commercial, while present activities involve tactical aircraft for the Army and Navy.

Accessories now in production include bomb shackles, hydraulic pressure accumulators, hydraulic relief valves, landing gear shock absorbers, machine-gun and cannon chargers, hydraulic selector valves, hydraulic actuating cylinders, and antiaircraft gunsight mechanisms.

National Machine Products has as its principal wartime business the manufacture, for leading aircraft companies, of bomb racks and bomb shackles of its own design, including





SAVE TIME ON FUSE PANELS

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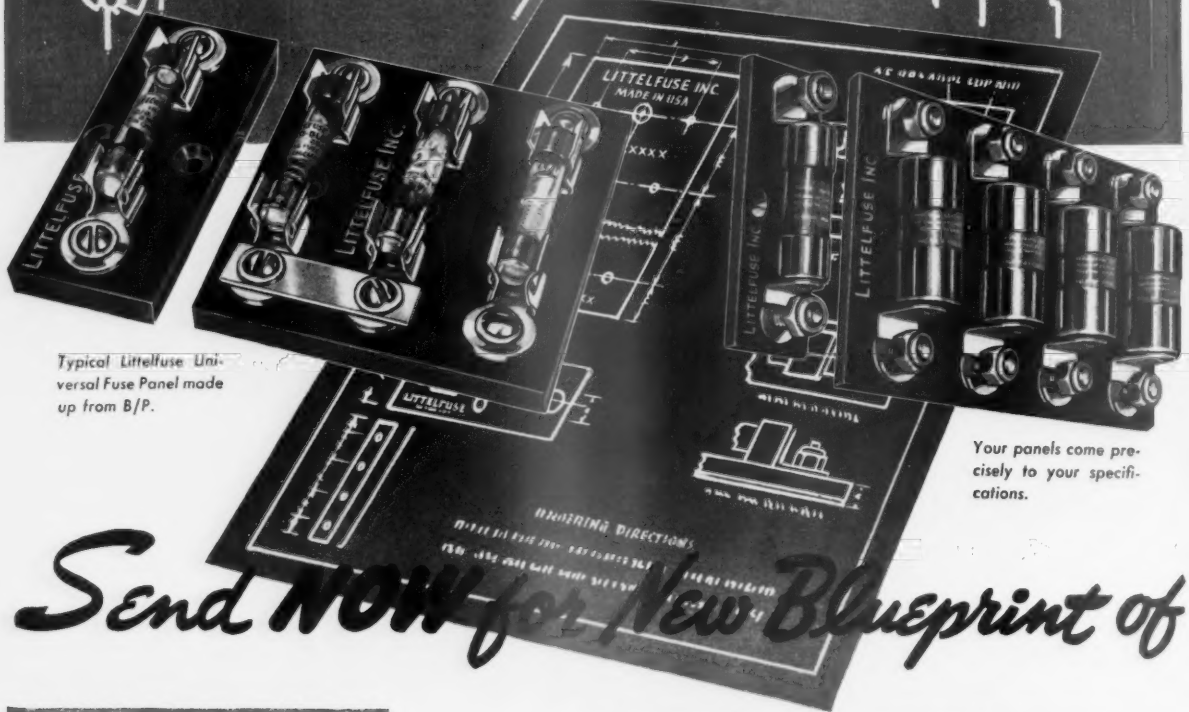

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its standard 1,600-lb. dual arming shackle, advanced trainer rack, bomb and chemical wing tank rack, and dual arming electric pursuit rack (wing type). Other developments include a fragmentation bomb shackle, a glider release, and an ammunition rounds counter.

Other products manufactured include gun mounts, control columns, and torque tube mechanisms.

Teleflex Limited manufactures mechanical remote controls of numerous types and is in production of single and multiple controls for Canadian-built aircraft.

The Teleflex system is designed to transmit positive control in tension or compression with a single cable. Construction of the cable is in the form of a flexible rack sliding in either a rigid or flexible conduit and will transmit a rotary or reciprocating motion or translate either to the other. It is probable that manufacture will soon be undertaken in the United States.

Sections and Branches

Buffalo Section

A preorganization meeting of the Buffalo Section of the Institute was held on April 27 in the Kleinhans Music Hall in Buffalo. Twenty-three hundred persons attended the meeting.

Igor Sikorsky was the speaker of the evening and showed films of the Sikorsky helicopter, accompanying them with a running commentary. Major Lester D. Gardner, Executive Vice-President of the Institute, attended the meeting and gave a short address.

Robert J. Woods, Chief Engineer of the Bell Aircraft Corporation, acted as temporary chairman of the Section, pending election of regular officers. The cooperating committee consisted of R. A. Darby, E. E. Foster, and V. J. Norris of the Curtiss-Wright Corporation and J. S. Limage, E. J. Pelletier, and R. A. Wolf of Bell Aircraft Corporation.

To defray the expenses of the meeting an admission fee of $0.50 was charged. As the attendance was greater than expected, the $500 surplus was donated to the Army Air Forces relief fund.

As it was impracticable to hold the organization meeting in the Kleinhans Music Hall, another meeting was held on May 20, at which time the films *Conquest of the Air* and *Wings of the Army* were shown. Ninety members attended.

The following officers were elected for the fiscal year ending April 1, 1944: Robert Darby, Chairman; Robert Stanley, Vice-Chairman; E. R. Child, Secretary; and R. K. Koegler, Treasurer. Members of the Advisory Committee include L. D. Bell and B. S. Wright, to serve until April 1, 1944, and Frederic Flader and R. J. Woods to serve until April 1, 1945.

Detroit Section

Peter Altman gave a talk on the subject of "A Plan for Increasing the Utility of Private Aircraft" at a dinner meeting of the Detroit Section on May 5.

Numerous ideas for increasing the market for civil aircraft were advanced during the discussion that followed the talk.

Academy of Aeronautics

During the month of April the activities of the Academy of Aeronautics Student Branch included awards for outstanding scholarship, presented at a general assembly of the engineering student body, as follows:

Term I: The book *Airplane Design Manual* by Teichmann, to Fritz Schmidt; Term II: a Deitzen Draft-Scale-Angle, to Milton Sobel; Term III: Volumes I and II of *Airplane Structures* by Niles and Newell, to Nelson Davies.

At the meeting on April 19 a paper titled "The Development of Armament" was presented by Nelson Davies. This paper covered the progress of aircraft armament.

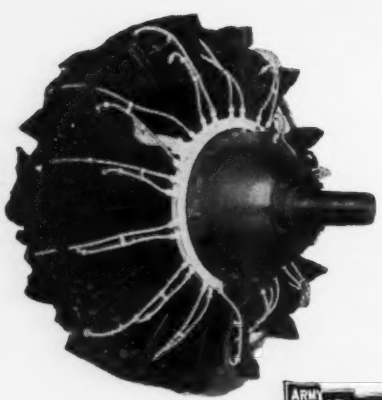
The Aeronautical University

At a meeting on April 20 one of the members gave a summary of his technical paper on "Plexiglas."

Alabama Polytechnic Institute

Professor Darling of the Electrical Engineering department was the speaker at a meeting held on the evening of April 13. His talk was devoted to the present-day application of radio and Radar to aeronautics.

MR. IGOR I. SIKORSKY
WILL LECTURE WITH MOTION PICTURES ON
HIS HELICOPTER
AT A PRE-ORGANIZATION MEETING OF THE
BUFFALO SECTION INSTITUTE OF THE AERONAUTICAL SCIENCES
ADMISSION BY TICKET ONLY
LADIES INVITED
A NOMINAL CHARGE OF 50¢
IS BEING MADE TO DEFRAY
EXPENSES
Tickets May Be Obtained from
THE KLEINHANS MUSIC HALL
APRIL 27th 8:30 P.M.



TO help our bombers reach the target *undetected* is one of the important functions of the TITEFLEX Radio Shielded Ignition Harness. With all ignition wiring virtually *sealed* within the TITEFLEX shielding assembly, powerful tell-tale signals from the planes' ignition system are not transmitted to enemy detection devices.

Moreover, clear radio communication can be maintained between our planes, and with their home bases. Such communication would be impossible if interference from the ignition systems was not eliminated through the use of efficient shielding.

Perfect Shielding . . . electrically leak-proof—this is the goal of TITEFLEX research engineers. Continuous experiments in new designs . . . tests in high altitude chambers . . . prolonged testing under temperature extremes . . . such research will produce the perfect shielding.

It is such research which produced the TITEFLEX Unimold lead . . . and which is responsible for TITEFLEX'S *continuing leadership* in ignition and power shielding. Titeflex Metal Hose Company, 514 Frelinghuysen Avenue, Newark, New Jersey.

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RADIO, POWER, AND IGNITION SHIELDING—CONDUIT, FITTINGS, COMPLETE ASSEMBLIES—HIGH PRESSURE FUEL, OIL AND AIR LINES

Casey Jones School of Aeronautics

At the regular meeting held on April 15 two films were exhibited, the *Lockheed 14*, and *Keep 'Em Flying*. A special meeting followed on April 16, at which plans were made for the dinner held on April 22. Institute emblems were presented to the new members at the meeting.

The film *Look to Lockheed for Leadership* was shown at a meeting on April 29, and at a meeting on May 13 two films furnished by The Glenn L. Martin Company, titled *Bomber* and *The Battle of Midway*, were exhibited.

Illinois Institute of Technology

The officers inducted at the opening meeting of the semester are as follows: Robert Erickson, Chairman; Harry Dolfi, Vice-Chairman; Jac Chamberlin, Secretary-Treasurer.

At a meeting on March 19 Mr. Blakely, the guest speaker, gave a talk on aircraft carburation.

The April 16 meeting was addressed by Prof. Albert Gail of the Aeronautical Engineering Department, who discussed the paper "Influence of Sweep on the Spanwise Lift Distribution of Wings," by F. Theilheimer, which appeared in the March, 1943, issue of the JOURNAL OF THE AERONAUTICAL SCIENCES. The speaker also commented briefly on the effect of ice on airplane performance.

North Carolina State College

New officers were elected at a meeting on April 20 as follows: Chairman, Cliff Spruill; Vice-Chairman, J. R. Bailey; Secretary and Treasurer, J. W. Bazemore; Recording Secretary, R. E. Allison; Reporter S. G. West, Jr.

Oklahoma A and M College

At a meeting on April 8 George Hanggi gave a talk on "Rocket Power for Assisted Takeoff." It was announced that the film *Messerschmitt 110* would be obtained and shown at the next meeting.

Wayne University

In a joint meeting with the Student Branch of the University of Detroit on April 16 two motion pictures on rotating wing aircraft were shown. The first film showed flight tests of several early and improved models of the Wilford gyroplane. The second showed the Focke-Achgelis helicopter.

Herbert Lissner, an instructor at Wayne University, was guest speaker of the evening, his topic being "Experimental Methods of Stress Analysis," illustrated by slides and charts.

Officers, directors, Army and Navy associates of the new National Aircraft War Production Council, Inc.

Left to right seated are: Frank F. Russell, J. Carlton Ward, Jr., Glenn L. Martin, LaMotte T. Cohu, T. Claude Ryan, Lawrence D. Bell.

Left to right standing are: Dr. A. E. Lombard, Col. Nelson Talbott, Clifford C. Goad, Robert Gross, Harry Woodhead, J. H. Kindelberger, G. W. Vaughan, Cortlandt Gross, Ralph Damon, Col. D. F. Stace, Capt. Lucian Grant, I. M. Laddon.

News of I.Ae.S. Members

Peter Altman, who recently resigned as Director of the Manufacturing Research Department of Vultee Aircraft, Inc., has been appointed Special Engineer Consultant for Continental Motors Corporation.

Edward P. Buckley has joined Vega Aircraft Corporation as Engineering Assistant.

William A. M. Burden, Special Aviation Assistant to the Secretary of Commerce, was elected Chairman of the War Aviation Committee of the Civil Aeronautics Administration.

Vivian James Chalwin has been appointed Manager of the Aircraft Repair Division of the Brush Electrical Engineering Company, Ltd., in England.

Richard C. du Pont resigned as President and Chairman of the Board of Directors of All American Aviation, Inc., to become Special Civilian Assistant to the Commanding General of the Army Air Forces. He will have charge of the glider program.

Roger F. Horton, Sales Manager of Dowty Equipment Corporation, has been appointed a member of the Hydraulic Pump Manufacturers Committee at Wright Field, which will work with the War Production Board and the Air Forces allocation group to expedite production of hydraulic equipment.

Gerald W. Fay has gone to Honolulu to join the Pacific Division of Pan American Airways.

Arthur M. Fitzpatrick, Jr., has become an associate of John Tjaarda & Associates.

Wallace M. Frei is now a Flight Analyst in the Flight Analysis Section of the Safety Regulation Bureau of the Civil Aeronautics Administration.

Andrew F. Haiduck has been elected Vice-President in Charge of Engineering at Bellanca Aircraft Corporation.

Robert W. Hambrook transferred to the Equipment Section of the Officer's War Training Program, following the closing by the Office of Education of its special aviation staff.

Sam R. Hamilton was recently appointed Instructor in the Aeronautical Engineering Department of the University of Minnesota.

Oscar E. F. Holt was transferred to the Louisville Plant of the Airplane Division of Curtiss-Wright Corporation as head of the Aerodynamics Department.

Barton T. Hulse transferred his activities from Columbus to the Buffalo Plant of the Curtiss-Wright Airplane Division, where he is connected with the Research Laboratory.

Robert Insley has been elected Vice-President and Executive Engineer of Continental Motors Corporation.

Inside this package there's something important...

UNTIL the war is over, there are very few things that we can tell you about the KLYSTRON* tube.

We can say that it is a vital factor in electronics, that it was developed by the Sperry Gyroscope Company following initial research at Stanford University.

Right now, the KLYSTRON* is making very important contributions to essential military equipment. And other advances in this field have been made—after the war is over, some of these will undoubtedly contribute to the security and comfort of a world at peace.

SPERRY

GYROSCOPE COMPANY

BROOKLYN, NEW YORK

DIVISION OF THE SPERRY CORPORATION

*The names KLYSTRON and RHUMBATRON were officially registered at the U. S. Patent Office on October 3, 1939, by Sperry Gyroscope Company, Inc. KLYSTRON is registration No. 371650. RHUMBATRON is registration No. 371651.

Felix Kallis resigned from Bell Aircraft Corporation and has assumed the position of Chief Aeronautical Engineer of the Southwest Aircraft Corporation and also of Southwest Airways, Inc., at Phoenix, Ariz.

Otto C. Koppen has joined the organization of the Henry J. Kaiser Company in the capacity of Chief of Design.

Eugene J. Korda is now the head of the Department of Design and Production Illustration at the Grand Central School of Art.

Alfred Marchev, Vice-President of Republic Aviation Corporation and General Manager of its Farmingdale plant, has been elected a director of the corporation.

Lee Ben Min has been named Engines Technical Assistant of the Chinese Air Force and is with the Washington office of Chinese Defense Supplies, Inc.

Joseph E. Migut is now Flight Test Engineering Supervisor at the Edward G. Budd Manufacturing Company.

Benham S. Pond has been appointed Director of the Special Development Division of Dowty Equipment Corporation.

August Raspet recently joined the Specialties Company as a Research Physicist.

Herbert W. Reed is now a Stress Analyst with Hoosier Aircraft Company.

John Rogers was recently appointed Supervisor of Engineering, Science, and Management of the War Training Program at Temple University.

Charles E. Rosendahl has been nominated by the President for promotion to the rank of Rear Admiral from his present rank of Captain. He has been assigned to take charge of a new training command for airship personnel at the Naval Air Station at Lakehurst.

Peter F. Rossman has been promoted to the position of General Manager of the Development Division of the Curtiss-Wright Airplane Division.

John E. Schuler has received his commission as a First Lieutenant Naval Aviator in the United States Marine Corps.

Manuel Silos, Jr., has joined Armco Engineering as a Tool and Machine Designer.

Fred W. Sturm has been advanced to the position of Test Engineer in charge of static load proof testing at Andover Kent Aviation Corporation.

Eugene Swanson recently joined the staff of Hoosier Aircraft Corporation, a subcontractor to Fairchild Aircraft Division, as an Engineer.

George B. Thorp is now an Engineer on the staff of Arens Controls, Inc.

George J. Wallace is Acting Assistant Chief Engineer of General Aircraft Corporation.

Hugh Willis has been advanced to the position of General Sales Manager of Sperry Gyroscope Company, Inc., succeeding the late M. Lynn Patterson.

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Elected to MEMBER Grade

Antonson, John Oscar, B.S.; Asst. Mgr., Research, The B. F. Goodrich Co.

Barrick, Ray Erford, B.S. in M.E.; Sr. Stress Analyst, The Glenn L. Martin Co.

Bartels, Robert Christian Frank, Ph.D.; Aero. Engineer, Structures Section, Bureau of Aeronautics, Navy Dept.

Bauer, Louis Hopewell, M.D.; Consultant & Med. Examiner, C.A.A.; Editor-in-Chief, *Journal of Aviation Medicine*, Aero. Medical Association of the United States.

Benckert, Willis Johnson, B.S. in Ae.E.; Stress Group Leader, The Glenn L. Martin Co.

Carlisle, Edgar Grafton, Jr., B.S.; Supt. of Flight Research, Canadian Pacific Air Lines Ltd., Canada.

Chapin, Lambert, M.A.E.; Experimental Engineer, The Chrysler Corp.

Gilgan, Joseph James, B.S. in E.E.; Stress Analyst, Boeing Aircraft Co.

Gray, William Lee, B.S. in M.E.; Stress Project Engineer, Wichita Div., Boeing Aircraft Co.

Hall, Stanley Ashbury, Flight Commander, Arizona Gliding Academy.

Hapke, Albert Theodore, Jr., Ph.B.; Asst. Director, Military Contracts, Republic Aviation Corp.

Harper, Thomas Campbell, Design & Construction Engineer, The B. F. Goodrich Co.

Harris, Charles Overton, Sc.D.; Asst. Prof. of Mechanics, Illinois Inst. of Tech.

Holben, Martin M., B.S. in M.E.; Project Engineer, Wright Aeronautical Corp.

Hoyt, John Robert, A.B.; Lt., Asst. Flight Training, U.S. Navy Flight Training, Navy Dept.

Hulett, Richard Bassett, B.S. in Ae.E.; Aerodynamicist, Willow Run Bomber Plant, Ford Motor Co.

Katzoff, Samuel, Ph.D.; Physicist, N.A.C.A.

Keller, Russel J. B., B.M.E.; Brake Engineer, The B. F. Goodrich Co.

Knight, John Herbert, C.E.; Assoc. Airport Engineer, C.A.A.

Kupelian, Vahey S., B.M.E.; Power Plant Engineer, Goodyear Aircraft Corp.

Lapin, Ellis, B.S. in M.E.; Aerodynamicist, Douglas Aircraft Co., Inc.

MacTernan, Frank Charles, III, B.S. in Ae.E.; Aero. Engineer, Hamilton Standard Propeller Div., United Aircraft Corp.

Medwecki, Joseph, Group Leader, Drawing Office, The DeHavilland Aircraft of Canada, Ltd.

Mills, John Burne, B.E.; Technical Manager, DeHavilland Aircraft Pty. Ltd., Australia.

Murbach, Jacob Frederick, B.E.; Asst. to Director, Patent Research Div., Manufacturer's Aircraft Association, Inc.

Nubar, Yves, Ph.D., C.E.; Aerodynamics Engineer, York Aircraft Corp.

Ogden, Albert S., B.S.; Chief Aerodynamicist, York Aircraft Corp.

Orr, Nolan Bristow, C.E.; Group Engineer, The Glenn L. Martin Co.

Patterson, William Allen, President, United Air Lines Transport Corp.

Redpath, Peter Harold, Chief Navigator, Transcontinental & Western Air, Inc.

Robins, Samuel Davis, B.S.; Consultant, Hopkinson Laboratories, Inc.

Saibel, Edward Aaron, Ph.D.; Assoc. Prof. of Mechanics, Carnegie Inst. of Tech.

Staniford, Joseph Warren, B.S. in Arch.; Sr. Layout, Lockheed Aircraft Corp.

Strehl, Gaylord LaVerne, M.S.E.; Sr. Stress Analyst, Lockheed Aircraft Corp.

Waze, Philip Arthur, Sr. Project Engineer, Eastern Aircraft Trenton Div., General Motors Corp.

Wilson, Gill Robb, D.Sc.; State Director of Aviation, State of New Jersey.

Elected to Industrial Member Grade

Ingram, Edward G., Assoc. Editor, AERONAUTICAL ENGINEERING REVIEW, Institute of the Aeronautical Sciences.

Reeve, Harris Franklin, Managing Editor, AERONAUTICAL ENGINEERING REVIEW, Institute of the Aeronautical Sciences.

Thomas, Albert Gaston, Maintenance Personnel Instructor, Pan American Airways System.

Thomas, Paul Walter, B.S. in Ec.; First Vice-President, G & A Aircraft, Inc.

Younger, C. J., Vice-President, Chase National Bank.

Elected to Technical Member Grade

Adams, John S., Jr., Cadet, U.S. Army Air Forces.

Allen, James William, Engineer, Boeing Aircraft Co.

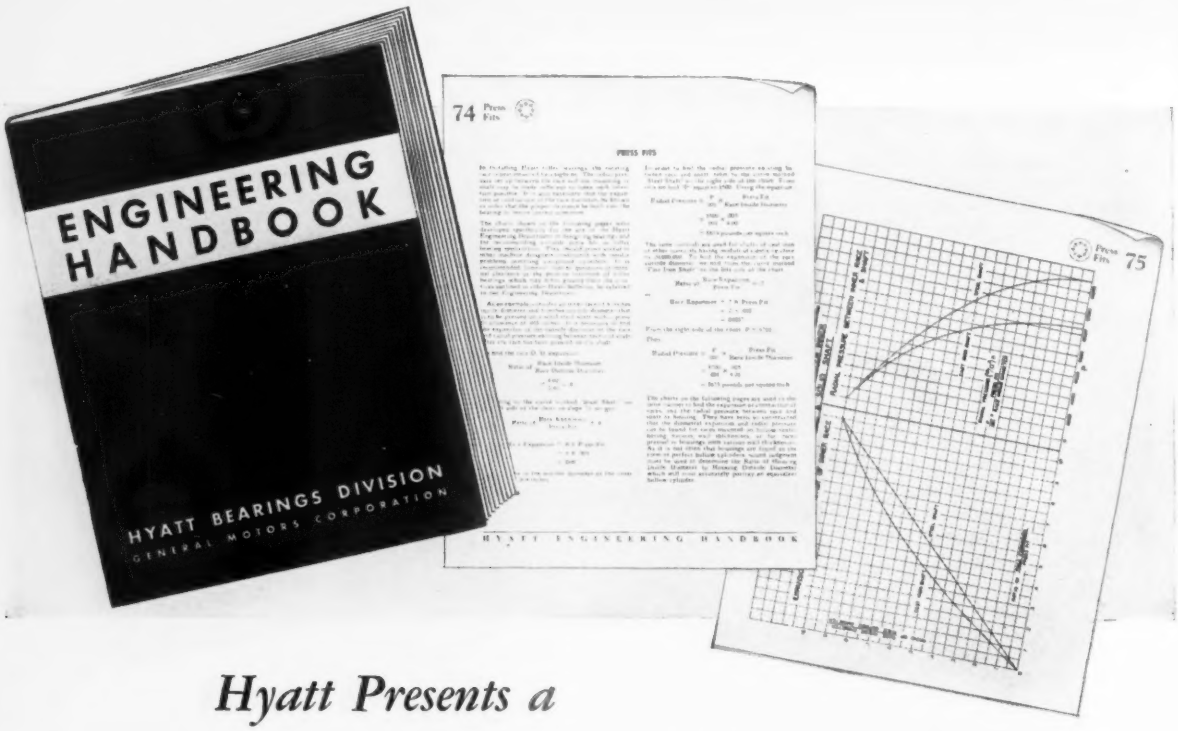
Bow, George Loch, B.S.; Chief Inspector, Lighter-than-Air; Goodyear Aircraft Corp.

Bull, Gifford, B.M.E.; Asst. Project Engineer, Sperry Gyroscope Co., Inc.

Carrington, James Howard, Flight Test Engineer & Aerodynamicist, Northrop Aircraft, Inc.

Chattler, Leo Morse, B.S. in M.E.; Ensign, Asst. to Chief, U.S. Navy.

Coleman, James Cuthbert Barrington, Foreman, Hydraulic Dept., Clark-Ruse Aircraft Ltd., Canada.



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It's a quick-reference manual... sort of a "scrap book" collection of fundamental engineering data such as you might assemble yourself, from various sources, to obviate the necessity of poring through numerous books to find certain formulae or data.

In addition, it contains much new material which eliminates lengthy calculations. For example, in the 10-page section on Press Fits, charts are used to determine the expansion and contraction of compound cylinders and the radial pressure existing between them. Desired information can be read directly from the charts.

A limited edition of this new 96-page Roller Bearing Engineering Handbook is now being distributed to leading engineers and designers throughout the country. A request on your company letterhead, stating your position, will bring you a copy with our compliments. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey

HYATT ROLLER BEARINGS

Dankenbring, Henry Dieter, B.S. in Ae.E.; Design Draftsman, The Glenn L. Martin Co.

Dardeck, Ben Victor, Engineering Draftsman, Vought Sikorsky Aircraft Corp.

Dehlinger, Hans, B.S.E.; Stress Analyst, The Glenn L. Martin Co.

Freeborn, Thomas Milton, Central Aircraft Ltd., Canada.

Gardner, Royal Cladene, B.S.; Research Engineer, Goodyear Aircraft Corp.

Gottlieb, Selma, B.A.; Aerodynamicist, Franklin Institute.

Harris, Joseph Raymond, Layout Draftsman & Group Leader, Waco Aircraft Co.

Jarck, Berneice Helen, A.B.; Assoc. Editor, AERONAUTICAL ENGINEERING REVIEW, Institute of the Aeronautical Sciences.

Kadlick, Frank Michael, Draftsman, Douglas Aircraft Co., Inc.

Kennedy, Robert Evan, B.S. in C.E.; Charge of Stress, Lighter-than-Air, Goodyear Aircraft Co., Inc.

Kleinman, Joseph Maurice, B.S. in A.E.; Assoc. Instructor Instruments, A.A.F. Technical Training Command.

Krouse, LeRoy, B.S. in Ae.E.; Stress Analyst, Bell Aircraft Corp.

MacClure, Robert Ian, Lt., Electrical & Mech. Engineer, R.E.M.E., Rolls-Royce, Ltd., England.

Mariano, Toribio S., B.S. in E.E.; Asst. Aero Engineer, Wright Field.

Marinelli, Joseph, Aero. Engineer, Power Plant Layout, Eastern Aircraft Div., General Motors Corp.

Mathers, Robert Leslie, Stress Analyst, Northrop Aircraft, Inc.

Nielsen, Jack Norman, B.S. in M.E.; Asst. Mech. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Parente, Anthony Robert, M.A.; Stress Analyst, Bristol Aeronautical Corp.

Peppler, Thomas Pinkney, B.S. in M.E.; Flight Test Engineer, The Glenn L. Martin Co.

Poppenhusen, Conrad Henry, Tool Designer, Timm Aircraft Co.

Rahn, Harold Christian, B.Ae.E.; Stress Engineer, Wichita Div., Boeing Aircraft Co.

Schell, Edwin Wright, B.S.; Jr. Asst. Flight Test Engineer, Consolidated Vultee Aircraft Corp.

Schramm, Herbert Theador, Process Toll Engineer, Stinson Aircraft Div., Consolidated Vultee Aircraft Corp.

Staudt, Robert Cronin, B.M.E.; Jr. Aero Engineer, Aircraft Engine Research Lab., N.A.C.A.

Sutkowski, George Peter, B.Ae.E.; Stress Engineer, Boeing Airplane Co.

Terry, Evan, Engineering Rep., Consolidated Vultee Aircraft Corp.

Voymas, James Steven, Power Plant Engineer, Consolidated Vultee Aircraft Corp.

Wadro, Gail, Assoc. Editor, AERONAUTICAL ENGINEERING REVIEW, Institute of the Aeronautical Sciences.

Watriss, Frederic Whitney, S.B.; Research Assoc., Mass. Inst. of Tech.

Transferred from Student to Technical Member Grade

Adams, Stewart Peter, Designer & Draftsman, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Ahrens, Donald James, B.S. in Ae.E.; Engineer, Cessna Aircraft Co.

Amatt, William Jr., B.Ae.E.; Jr. Engineer, Airplane Div., Curtiss-Wright Corp.

Arnold, Alison Mansfield, B.S. in M.E.; Engineering Asst., Lockheed Aircraft Corp.

Arnow, Leonard, B.A.E.; Aero. Engineer, Douglas Aircraft Co., Inc.

Bergeron, Paul Jean, Specification Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Bush, Walter Roy, B.A.E.; Research Engineer, Republic Aviation Corp.

Carroll, Frank Theodore, Jr., B.S. in M.E.; 2nd Lt., U.S. Army Air Forces.

Clarke, Martyn Victor, B.A.E.; Engineer, Douglas Aircraft Co., Inc.

Dempsey, Walter W., Aero. Engineer, The Dow Chemical Co.

Dietrich, Fred Herman, B.S. in Ae.E.; Officer Candidate, U.S. Army Air Forces.

Dietz, Robert E.

Dooley, James Ervin, Ae.E.; Officer Candidate, U.S. Army Air Forces.

Drake, Hubert Munson, B.S. in Ae.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Ebin, Joseph Alexander, B.A.E.; U.S. Army.

Fleddermann, Richard Grayson, B.S. in Ae.E.; Aerodynamicist, El Segundo Div., Douglas Aircraft Co., Inc.

Frisch, Edward, Stress Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Funk, Jack, B.S. in A.E.; Jr. Aero Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Grady, Walter F., B.S. in Ae.E.; Jr. Aero. Engineer, U.S. Army Air Forces, Wright Field.

Gregorius, Thomas Karl, B.S. in M.E.; 2nd Lt., U.S. Army Air Forces.

Goldberg, Harry Morris, B.A.E.; Aerodynamicist, United Aircraft Corp.

Hardin, William Ross, B.S. in Ae.E.; Jr. Engineer, El Segundo Div., Douglas Aircraft Co., Inc.

Harrigan, William Patrick, Ae.E.; Flight Test Engineer, Airplane Div., Curtiss-Wright Corp.

Hertzberg, Abraham, B.S. in Ae.E.; Jr. Engineer, Airplane Div., Curtiss-Wright Corp.

Kouns, John Henry, B.S. in Ae.E.; Engineer, Bell Aircraft Corp.

Lechenger, Louis Charles Rafael, B.S. in M.E.; Ensign, A-V(P), U.S.N.R.

Lenert, August Albert, Jr., B.S. in Ae.E.; Officer Candidate, U.S. Army Air Forces.

Lettvin, Norman, B.S. in C.E.; Jr. Engineer, Aircraft Engine Research Lab., N.A.C.A.

Limke, Eugene John.

Lombardo, Thomas Peter, B.Ae.E.; Aviation Cadet, U.S. Army Air Forces.

Malvestuto, Frank Stephen, B.S. in Ae.E.; Jr. Research Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Marquardt, Roy, M.S.; Aerodynamicist, Northrop Aircraft, Inc.

Martenson, Carroll, B.S. in Ae.E.; Ensign, U.S.N.R.

McHenry, Frank Raymond, Ae.E.; Sr. Stress Computer, Lockheed Aircraft Corp.

McQuilkin, Frederick Taylor, B.S. in M.E.; Jr. Detailer, North American Aviation, Inc.

McRoberts, Donald Newton, B.S. in Ae.E.; Engineering Asst., Lockheed Aircraft Corp.

Medici, Joseph John, B.S. in M.E.; Jr. Aero. Engineer, Wright Field.

Mitchiner, Simon Turner, B.Ae.E.; Student Engineer, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Mullaney, George Joseph, B.A. in Ae.E.; Stress Analyst, Chance Vought Aircraft Div., United Aircraft Corp.

Okawa, Jesse.

Painter, Warren, B.Ae.E.; Stress Analyst, Airplane Div., Curtiss-Wright Corp.

Payne, Louis Amos, A.E.; Corporal, U.S. Army Air Forces.

Perlin, Jordan, B.Ae.E.; Jr. Facilities Engineer, Kollmorgen Optical Corp.

Pratt, Kermit George, B.Ae.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Pych, Theodore John, Aero. Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Co.

Rasmussen, Leonard Joseph, B.Ae.E.; Aviation Cadet, U.S. Naval Air Corps.

Rechler, Morton Daniel, B.Ae.E.; Aviation Cadet, U.S. Army Air Forces.

Reznicek, William John, B.Ae.E.; Douglas Aircraft Co., Inc.

Rossow, Paul Norman, B.Ae.E.; Cadet, U.S. Army.

Rubin, Joseph, B.S. in Ae.E.; Aviation Cadet, U.S. Army Air Forces.

Schade, Robert Oliver, B.S. in A.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Scharnberg, Russell Conrad, B.S. in Ae.E.; Private, U.S. Army Air Forces.

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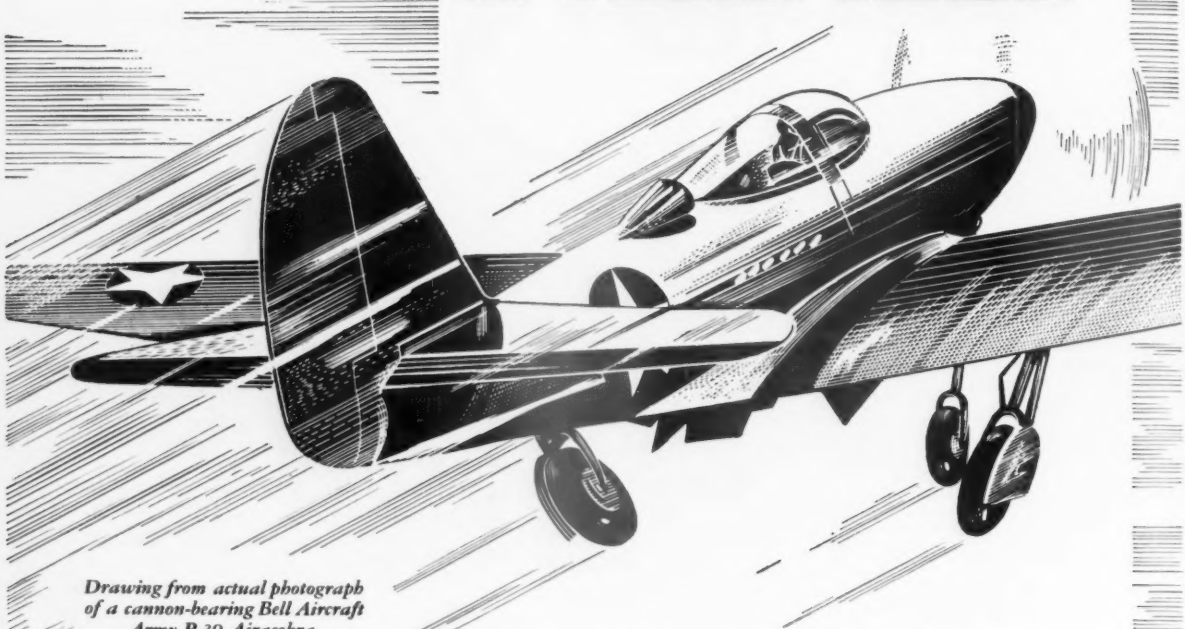

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Stern, Mayer, B.S. in Ae.E.

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Stewart, Lawrence Estabrook, S.B. in Ae.E.; Ensign, U.S.N.R.

Thomas, Morton Irwin, Aero. Structural Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Thompson, Robert Emerson, B.S. in A.E.; Aviation Cadet, U.S. Army Air Forces.

Vaffis, John C.

Velkoff, Henry, B.S. in M.E.; Engineering Asst., Lockheed Aircraft Corp.

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Waeldner, William John, Jr., B.S. in Ae.E.; Engineering Trainee, Propeller Div., Curtiss-Wright Corp.

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Williams, Edgar Purell, Ae.E.; Aerodynamicist, Douglas Aircraft Co., Inc.

Winslow, William R., B.Ae.E.; Jr. Flight Test Engineer, Airplane Div., Curtiss-Wright Corp.

Wischmeyer, Irving John Arthur, Jr. Layout Draftsman, Ryan Aeronautical Co.

Woodward, Arthur Whitsel, B.S. in Ae.E.; Jr. Aero. Engineer, Aircraft Engine Research Lab.

Wyche, Benjamin Walker, Jr., B.S. in Ae.E.; Officer Candidate, U.S. Army Air Forces.

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Cunningham, James Read, B.A., Science Teacher, Franciscan Brothers of Brooklyn.

Gardner, Perry Lockwood, Chief Draftsman & Asst. Engineer, Bruns Kimball & Co.

Genser, Maurice Leonard, M.A.; Asst. Instructor, Army Air Forces Technical School.

Hildt, John McLean, Jr., Ternstedt Mfg. Div., General Motors Corp.

Montero M., Celso Fco., Dominican Republic National Army.

Raisen, Tex Milton, Sr. Aero. Detail Draftsman, Kellett Autogiro Corp.

Reichers, Anna E., B.A.; Service Engineer, Consolidated Vultee Aircraft Corp.

Rice, Arthur Henry, A.B.; Director of Education & Editor, The National Exchange Club; Aviation Correspondent.

Shotz, Sidney A., Asst. Instructor, Army Air Forces Technical School.

Necrology

Howard Burtis Dilatush, Jr.

Howard Burtis Dilatush, Jr., was killed in an airplane accident while performing his duties as an Assistant Flight Test Engineer connected with the United States Naval Air Station at Anacostia, D.C.

He was born at Seattle, Wash., June 5, 1914, and received his degree of Bachelor of Science in Aeronautical Engineering at the University of Washington in June, 1939. From then until 1941 he was engaged in stress analysis work at the Ryan Aeronautical Company at San Diego, Calif. In 1941 he was appointed to the service of the Government and moved to Washington, continuing his work in flight testing until the time of his death.

Walter Wynne Webster

Walter Wynne Webster, a Captain in the U.S. Navy and Manager of the Naval Aircraft Factory at Philadelphia, lost his life on March 16, 1943, in his fifty-fifth year in an accident while making a routine flight to Washington.

A native of Fargo, N.D., where he was born July 28, 1888, Captain Webster graduated from the U.S. Naval Academy in 1911 and also took degrees of Bachelor and Master of Science in Naval Architecture from Massachusetts Institute of Technology. From 1916 to 1920 he was assigned to the Puget Sound Navy Yard, holding the titles successively of Assistant Shop Superintendent, Assistant Inside Superintendent, and Assistant Outside Superintendent, after which he was transferred to the New York Navy Yard as Shop Superintendent, Hull Division.

From 1922 to 1925 he was in the Airplane Design Division of the Bureau of Aeronautics and in the latter year was made Production Superintendent at the Naval Aircraft Factory, advancing to Chief Engineer there in 1927. Returning to the Bureau of Aeronautics in 1929, Captain Webster served as Head of Airplane Design until 1933, when he was assigned to training as a Naval Aviator at the Pensacola Naval Air Station. Since 1936 he had been Manager of the Naval Aircraft Factory and since 1941 was Director of Materials for the Bureau of Aeronautics.

Personnel Opportunities

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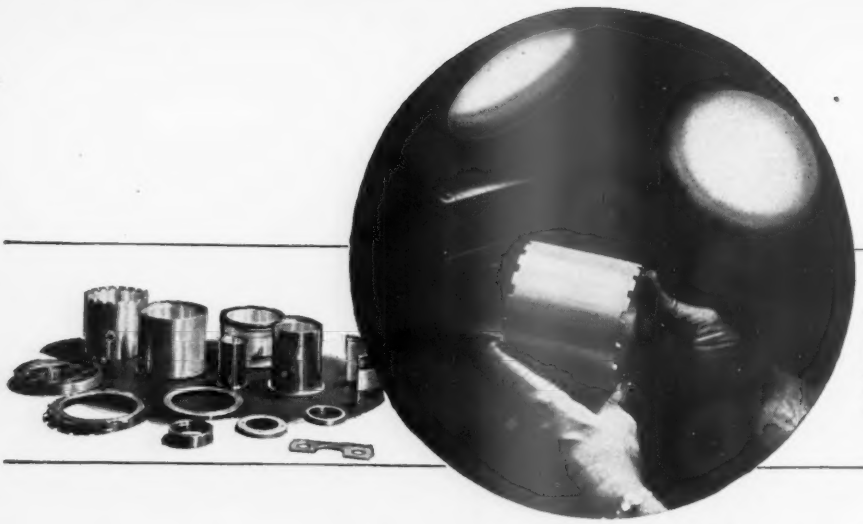

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ROMEC PUMP COMPANY

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AULT & WIBORG CORPORATION

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CHIKSAN TOOL COMPANY
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SHAKESPEARE PRODUCTS COMPANY
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FITTINGS, STRUCTURAL
THE WEATHERHEAD COMPANY

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BREEZE CORPORATIONS, INC.

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EDO AIRCRAFT CORPORATION
FIRESTONE AIRCRAFT COMPANY
THE GOODYEAR TIRE & RUBBER COMPANY
TECHNICAL PLY-WOODS

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ALUMINUM COMPANY OF AMERICA

FLYING SUITS
GENERAL ELECTRIC COMPANY
UNITED STATES RUBBER COMPANY

FORGINGS
ALUMINUM COMPANY OF AMERICA
THE WEATHERHEAD COMPANY
WYMAN-GORDON COMPANY

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BENDIX AVIATION CORPORATION
CHANDLER-EVANS CORPORATION
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ALUMINUM COMPANY OF AMERICA
BELL AIRCRAFT CORPORATION
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BREEZE CORPORATIONS, INC.
LITTELFUSE INCORPORATED

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CELANESE CELLULOID CORPORATION
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EICOR, INC.
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CASEIN COMPANY OF AMERICA
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BREEZE CORPORATIONS, INC.
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THE GOODYEAR TIRE & RUBBER COMPANY
RESISTOFLEX CORPORATION
TITEFLEX METAL HOSE COMPANY
UNITED STATES RUBBER COMPANY
THE WEATHERHEAD COMPANY

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CHIKSAN TOOL COMPANY
FLEETWINGS, INC.
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PUMP ENGINEERING SERVICE CORPORATION
ROMEC PUMP COMPANY
SCOTT AVIATION CORPORATION
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WARNER AIRCRAFT CORPORATION
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BENDIX AVIATION CORPORATION
THE CRESCENT COMPANY
GENERAL ELECTRIC COMPANY
PACKARD ELECTRIC DIVISION, GENERAL MOTORS CORPORATION

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BENDIX AVIATION CORPORATION
GENERAL ELECTRIC COMPANY
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REYNOLDS METALS COMPANY
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MICA INSULATOR COMPANY
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UNITED STATES RUBBER COMPANY

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STANDARD OIL COMPANY (INDIANA)
STANDARD OIL COMPANY OF NEW JERSEY
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THE BG CORPORATION
CHAMPION SPARK PLUG COMPANY
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PLUMBING
THE PARKER APPLIANCE COMPANY
THE WEATHERHEAD COMPANY

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HASKELITE MANUFACTURING CORPORATION
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TECHNICAL PLY-WOODS
UNITED STATES PLYWOOD CORPORATION

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for the boys "upstairs"

NO LONGER ARE BLIND SPOTS the flyer's nightmare. Now pilots, bombardiers and gunners have "greenhouses" to let them see clearly, above, below and all around.

At the "University of Petroleum," Shell's research laboratories, a way was found to combine molecules from petroleum gases which makes possible the molding of these smooth, tough, transparent globes of open "daylight."

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DOWTY EQUIPMENT CORPORATION
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BENDIX AVIATION CORPORATION
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SCOTT AVIATION CORPORATION

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FIRESTONE AIRCRAFT COMPANY
THE GENERAL TIRE & RUBBER COMPANY
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BENDIX AVIATION CORPORATION

SKIDS
SCOTT AVIATION CORPORATION

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ALUMINUM COMPANY OF AMERICA

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CHAMPION SPARK PLUG COMPANY
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FIRESTONE AIRCRAFT COMPANY

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AULT & WIBORG CORPORATION
FIRESTONE AIRCRAFT COMPANY
THE B. F. GOODRICH COMPANY
UNITED STATES RUBBER COMPANY

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AULT & WIBORG CORPORATION
CASEIN COMPANY OF AMERICA
FIRESTONE AIRCRAFT COMPANY
THE B. F. GOODRICH COMPANY
THE PARKER APPLIANCE COMPANY
THE RESINOUS PRODUCTS & CHEMICAL COMPANY
UNITED STATES RUBBER COMPANY

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BARBOUR STOCKWELL COMPANY
BENDIX AVIATION CORPORATION
GENERAL ELECTRIC COMPANY
KOLLSMAN INSTRUMENT DIVISION, SQUARE D COMPANY
STEWART-WARNER CORPORATION
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WESTON ELECTRICAL INSTRUMENT CORPORATION

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DOWTY EQUIPMENT CORPORATION
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THE B. F. GOODRICH COMPANY
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THE GOODYEAR TIRE & RUBBER COMPANY
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ENGINEERING & RESEARCH CORPORATION
THE PARKER APPLIANCE COMPANY
WHITING CORPORATION

TOOLS, PORTABLE
THE PARKER APPLIANCE COMPANY
SPEEDWAY MANUFACTURING COMPANY
WHITING CORPORATION

TRACTORS AND SNOW REMOVAL EQUIPMENT
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AMERICAN FELT COMPANY

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BREEZE CORPORATIONS, INC.
CELANESE CELLULOID CORPORATION
FIRESTONE AIRCRAFT COMPANY
RESISTOFLEX CORPORATION
TITEFLEX METAL HOSE COMPANY
UNITED STATES RUBBER COMPANY
THE WEATHERHEAD COMPANY

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CELANESE CELLULOID CORPORATION
REYNOLDS METALS COMPANY
UNITED STATES PLYWOOD CORPORATION

TUBING, RIGID, STEEL
SUMMERILL TUBING COMPANY

TUBING, RUBBER
FIRESTONE AIRCRAFT COMPANY
THE B. F. GOODRICH COMPANY
UNITED STATES RUBBER COMPANY
THE WEATHERHEAD COMPANY

TUBING, STAINLESS STEEL
SUMMERILL TUBING COMPANY

TUBING, STREAMLINE
ALUMINUM COMPANY OF AMERICA
FIRESTONE AIRCRAFT COMPANY
SUMMERILL TUBING COMPANY

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FIRESTONE AIRCRAFT COMPANY
UNITED STATES RUBBER COMPANY

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EATON MANUFACTURING COMPANY
THE PARKER APPLIANCE COMPANY
PUMP ENGINEERING SERVICE CORPORATION
ROMEC PUMP COMPANY
THOMPSON PRODUCTS, INC.
THE WEATHERHEAD COMPANY

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AMERICAN FELT COMPANY
FIRESTONE AIRCRAFT COMPANY
THE B. F. GOODRICH COMPANY
UNITED STATES RUBBER COMPANY

WASHERS, SHOCK
FIRESTONE AIRCRAFT COMPANY
THE B. F. GOODRICH COMPANY
UNITED STATES RUBBER COMPANY

WEBBING
FIRESTONE AIRCRAFT COMPANY
WELLINGTON SEARS COMPANY

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GENERAL ELECTRIC COMPANY
LINCOLN ELECTRIC COMPANY
P. R. MALLORY & COMPANY, INC
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"I'm going to shock you!"

"Because I'm going to hit right from the shoulder, starting now.

"Out there, our boys are fighting, and they're falling. Not one or two at a time, picked off by a nice clean bullet. But fifty at a time in the roaring, flaming hell of a shell burst.

"Out there, they aren't walking around in clean white uniforms on neat decks. They're running and slipping around on the bloody heaving flanks of a carrier foundering in a sea of oil with her guts torn out.

"They're not lying in cool, immaculate hospital beds with pretty nurses to hold their hands. They're flat on their backs on cold steel taking a smoke and waiting for a doctor to get through with the *seriously* wounded.

"Out there, they're fighting and they're falling but they're winning! And get this straight —they're not complaining. But I want you to know what they're up against. I want you to know they look to you to give them in *your* way the same full measure of help and devotion they get unasked from their own shipmates.

"And you *can* help them—by giving generously to the Red Cross.

"If you had seen the faces of men pulled naked from the sea as they received kit bags and cigarettes handed out on the spot by Red Cross Field Directors—you'd know what I mean!"

* * *

On every front the Red Cross presses forward. Each day, the need increases for your support.

Your Chapter is raising its Second War Fund in March. Give more this year—give double if you can.

THE RECORD SINCE PEARL HARBOR

For the Armed Forces—More than one million and a half service men have received, through the Field Staff, practical help in personal problems. The Red Cross is with them in training and at the front. For morale and recreation, over one hundred Red Cross Clubs have been established for overseas troops. There are more than five thousand workers in the field.

Civilian Relief—About sixty million dollars in war relief has been administered in every allied country. Food, clothing, medicinal supplies have gone to Great Britain, Russia, China, Africa, for Polish and Greek refugees, and many others.

Thousands of packages to prisoners of war have been safely delivered through cooperation with the International Red Cross in Switzerland.

The Home Front—Training our people to meet the needs of war. Millions of First Aid Courses. Hundreds of thousands trained in Home Nursing and Nutrition Courses. Thousands enlisted as Nurses' Aides and in Motor and Canteen and Staff Assistant Corps.

More than one million and a half blood donations through Red Cross collection centers and the distribution of the life saving Plasma wherever needed.

Chapter Production rooms from coast-to-coast providing surgical dressings for the wounded, kit bags for the fighters and tons of clothing for relief.

The Red Cross record in this war is one that we Americans may well be proud of—and support.

Your Dollars help make possible the

AMERICAN RED CROSS

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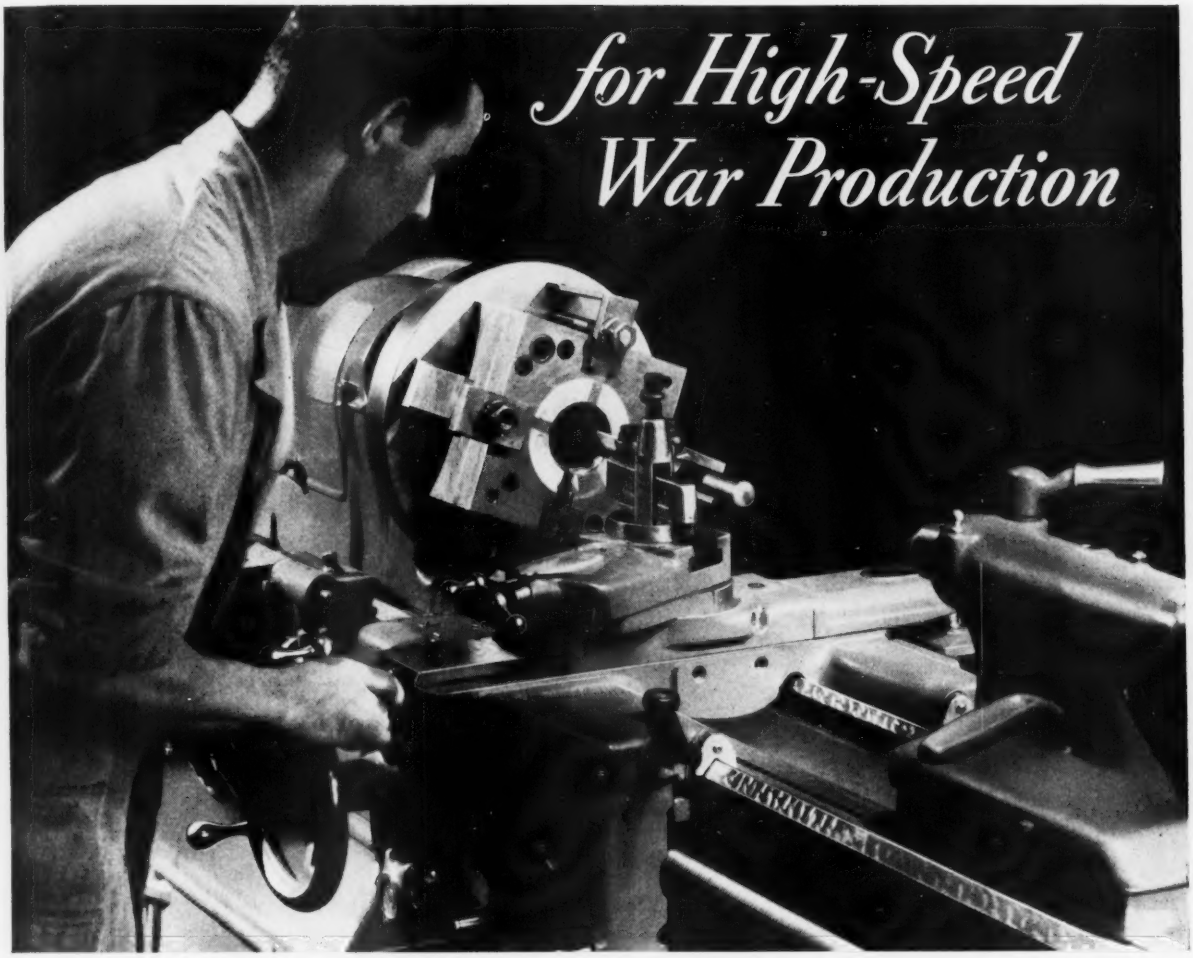
HIGH PRECISION



High precision is the key to high speed war production—for mass production is based on a degree of accuracy that assures the perfect interchangeability of parts and units.

In hundreds of war production plants, South Bend Lathes are preferred because their high precision makes it easier to maintain exacting tolerances on important toolroom and production operations.

Modern in design, built to the highest standards of workmanship, South Bend Lathes are capable of performing finish turning and boring operations with such accuracy that subsequent grinding, honing, or lapping operations can often be eliminated. A wide range of spindle speeds permits taking full advantage of carbide or diamond tipped tools.

Convenient controls make for an ease of operation which reduces fatigue and lessens the possibility of error. Requiring a minimum of effort to run, South Bend Lathes are especially desirable where women lathe operators are employed. Write for your copy of Catalog 100C which describes South Bend Engine Lathes, Toolroom Lathes and Turret Lathes.

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"HOW TO RUN A LATHE"

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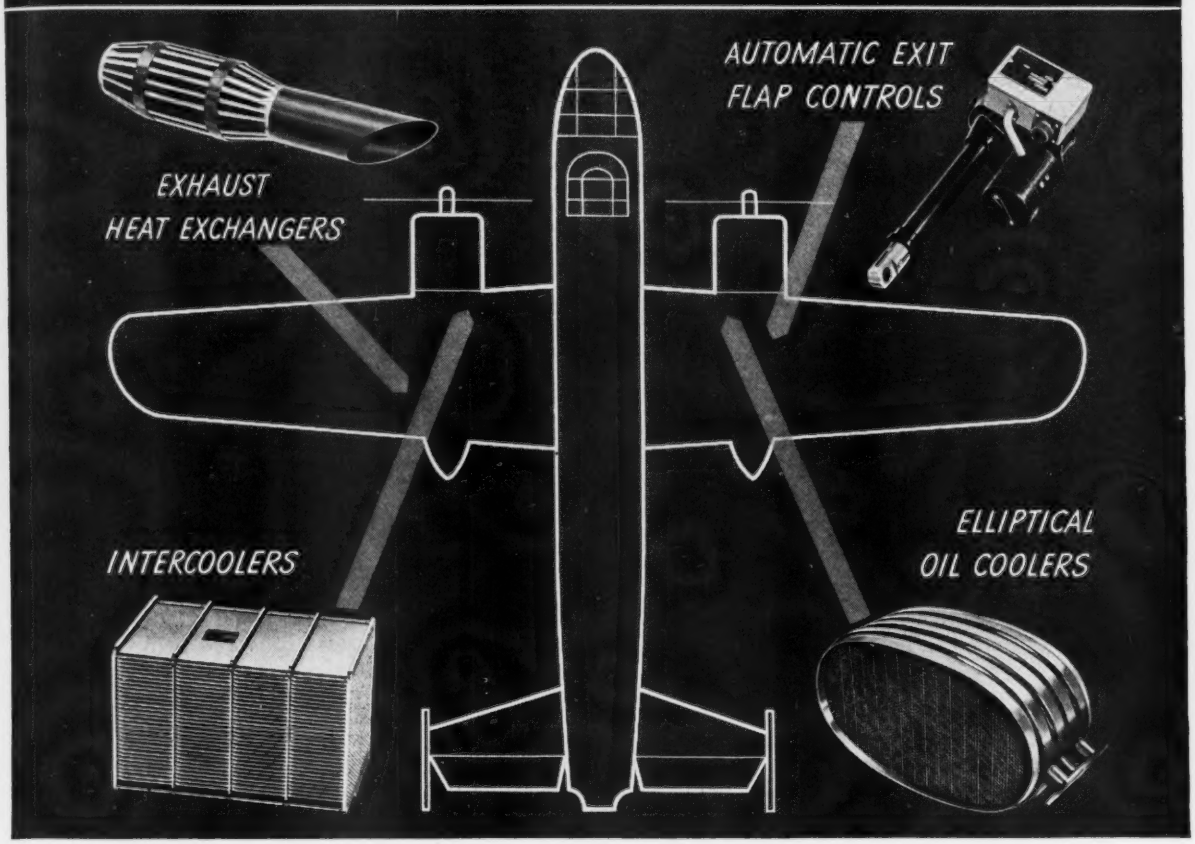
Four AiResearch developments . . .



They *boost altitudes . . . increase speed . . . provide greater safety for* U.S. *aircraft*

FOR THE PRESENT, a good many AiResearch high altitude, pressure and temperature control products must remain closely guarded secrets.

But the records of four have been released for publication. And the "edges" they add to American warplane performance can be told.

Intercoolers. Pioneering the development of this equipment, AiResearch cut weight . . . increased ruggedness . . . stepped up cooling efficiency. Result: AiResearch Intercoolers are helping the power plants of thousands of American airplanes deliver *added useable power at critical altitudes.*

Automatic Exit Flap Control. AiResearch's system operates on standard voltage without capillary tubes, sylphon bellows or electronic circuits. It provides considerable freedom from instrument watching, cuts open flap-time, reduces cooling drag—can add 10 to 20 miles per hour *extra speed.*

Exhaust Heat Exchangers. Installed as a part of the exhaust pipe, this lightweight AiResearch unit is complete in itself. Requires no auxiliary equipment. And it operates with little or no drain on engine power because back pressure is nominal.

Elliptical Oil Coolers. AiResearch developed a special type of pressure-stressing to achieve this "oil cooler that couldn't be built." Now in volume production, the AiResearch elliptical design makes possible greater freedom of designing . . . simplifies oil cooler installation . . . provides important savings in weight and space.

Further information on these and other AiResearch developments is offered to all U.S. aircraft manufacturers.

Inquiries are invited.

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"Where Controlled Air Does The Job" **Automatic Exit Flap Control Systems • Engine Oil Cooling Systems • Exhaust Heat Exchangers • Engine Air Intercooling Systems • Supercharger Aftercooling Systems**

Speaking of superior races . . .

EVERY WHEEL that rolls on the battlefield turns in a polished bearing race, ruggedly built to take the terrific shock of combat service.

To withstand such punishment, bearing races must be hardened by heat-treatment. Hard and soft spots occasionally occur. Such races may fail—at times when failure means disaster.

Recognizing the vital need, Westinghouse Research Engineers set to work to develop a quick, sure method of detecting these flaws.

Their ingenious electromagnetic flaw-detector is based upon the fundamental law that the *permeability* of a heat-treated steel part varies with the degree of hardness.

In actual practice, the bearing race is *completely* demagnetized. Then it is rapidly rotated and strongly magnetized. While the race is still turning at high speed, its magnetic field is explored with a specially designed electromagnetic "pick-up."

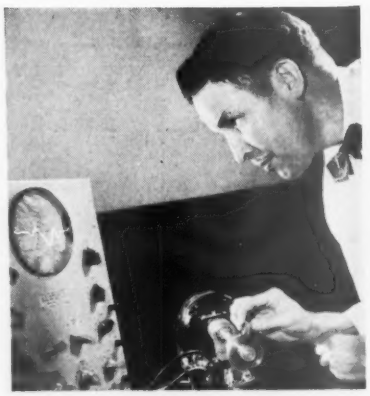
Variations in the magnetic field of the bearing race, due to hard or soft spots, induce feeble currents in the pick-up system. These currents are amplified and shown visibly on a cathode-ray oscilloscope.

A uniformly heat-treated bearing race traces a *luminous straight line* on the oscilloscope screen. Faulty heat-treating shows up as a pattern of *hills and valleys*.

The electromagnetic flaw-detector is now being used commercially—a typical example of Westinghouse *electronics at work*.

It assures quality in millions of bearing races for our armed forces, to keep 'em rolling on to victory!

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.



Electronic fingerprints — A Westinghouse Research Engineer demonstrates the principle of the electromagnetic flaw-detector. Hard spots in the steel test piece show up as an irregular line on the oscilloscope screen.

Westinghouse

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Electronics at Work

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And so, the U. S. Navy has recorded an amazing safety record. For example, deaths from crash-fire accidents aboard carriers are virtually unknown. Carbon dioxide equipment helped make the record.

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Orders for these cylinders can now be filled promptly, due to increased production. New uses for pressure gases are being found daily. Perhaps they can solve *your* problem. For advice, write to Walter Kidde & Company, 612 Main St., Belleville, N. J.

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a Dependable Guide for Flying Armor...

Sketched in the Pioneer Compass Laboratory by Norman Kenyon

. . . Pioneer ingenuity provides the solution

Adverse influences on the magnetic compass in a modern fighter are the heavy armor plate, guns, and maze of electrical wiring... all concentrated in and around the cockpit. Hence the need for a remote indicating compass with its sensitive element located away from such magnetic disturbances.

Before the outbreak of war, Pioneer engineers had conducted extensive research on the general problem of remote indicating instruments. And because of these years of development work, the "PIONEER MAGNESYN" Remote Indicating Compass was soon perfected to meet the urgent need of the day.

In this system, the Transmitter containing the sensitive element is located where magnetic disturbances are at a minimum. From one to three Indicators connected to it by electrical wiring are installed at points in the plane where compass indications are needed.

The "MAGNESYN" Remote Indicating Compas
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coast are speeding to our fighting crews
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